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THE FOUNDRY

A TRADE JOURNAL

DEVOTED TO THE INTERESTS OF THE WHOLE FOUNDRY BUSINESS

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DETROIT, MICH.

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MASS. INSTITUTE

THE FOUNDRY

VOL. 8. DETROIT, MICH., OCT., 1896. No. 50

Cupola Practice.

H. M. RAMP.

PART II.

The center of the cupola requires very little blast, theoretically none; but the instant you move from the center on the radius the amount of blast required is constantly increased, for the area represents the blast necessity. The nearer the side of the cupola is approached, the greater demand it makes upon the blast volume, for if our blast was sufficiently concentrated and of such power as to force its major portion to the center the outside area would be robbed and cooled and cause greater disaster. For example, assume that in a 48-inch cupola the blast does not penetrate within six inches of the center, which would leave a circle of twelve inches in diameter in that point unsupplied with blast, a melting area of 113 square inches. Or, again, assume you reach the center, and the force and volume of the blast are so great you cooled the cinders and droppings around the outside diameter one inch thick, or forced the blast in so one inch would be neglected. The result would be that one inch on the outside diameter would cut off 150 square inches of melting area, considerably more than a twelve-inch circle in the center. Yet how often the cupola bottom is dropped and one, two, three, yes, and even six inches of accumulations will be found hanging to the side above the tuyers, cutting off hundreds of inches of melting area. Most certainly there is a reason for both of these conditions, and it is often the direct result of the dimensions of tuyers used. If the cupola accumulates around the edge, the tuyers are too large; too great a body of air is entering at one point, which cools anything that may be in its path before it becomes sufficiently heated. Too high blast pressure will also cause the same result.

Many cupolas are driven beyond their capacity the first hour and melt rapidly, but gradually bring up and melt slower until at the end of the second hour their usefulness is at a practical end for that heat.

The outside diameter of melting area is the portion that should meet our attention and consideration first; the center later.

The cupola that works well all through a heat of two, three or four hours and drops clean and clear will be found a rapid and economical one to use, and the blast and tuyers will most certainly represent correct proportions. Center blast attachments are of comparatively recent origin, and their application is successful and economical, but the name "center blast" conveys the wrong impression. Practically our old style cupolas are center blast, for that is the point to which they endeavor to force the blast, while the so-called center blast of to-day is situated in the center and forces the blast to the outside diameter, the very point where it is needed most, and it is only plausible to suppose a cupola operated with one of these must constitute a great saving in time, wear of lining, to say nothing of possible economy in fuel, and, futhermore, is an exemplification of the idea just advanced that the outside melting area is of more importance than the center. Distribution of the tuyers or blast volume varies. Some cupolas have only four to six tuyers, while others will possess forty. One of the best working cupolas the writer ever saw had thirty-six two and one-half inch round tuyers, and the iron melted hot at a low ratio of fuel and great rapidity. But the practice of placing four or six large tuyers in a cupola of forty-eight inches diameter is undoubtedly an error, for the points between the tuyers do not receive their full quota of blast, and the points in front of the same are chilled and cooled by the excessive volume. Running a cupola correctly is based on common sense rules, and the reason so many mysterious, unexplainable things occur is simply because we have not sufficiently exercised our thinking faculties. Eliminate everything that is not rea-

sonable, and different results will be ob tained or cause shown why. If we were constructing a stove, we would not devote all energies to getting a draught to the center of the fire alone, but also to the ends and sides, which develop heat according to area contained.

Mr. Grindrod, in "Management of Cupolas," April Foundry, stands on one point and assumes the correct management of a cupola lays principally in the charging. There is no doubt but that the method of charging and the proportions employed regulate the success of the heat, and that he is correct in his assertions as far as the conditions he worked under were concerned, but there are many cases where this does not hold good, cases where judgment is required and blind obedience to any rule would lead to trouble. heats of fifteen tons melted at a ratio of one For example, he states a 42-inch cupola with tuyers 12 inches from the bottom requires 630 pounds of coke for a bed, while no difference is made or spoken of if pig-iron or scrap is to be melted or whether the iron is to pour heavy work or stove plate. For this reason it is almost impossible to lay down any set rule, although, as Mr. Grimod says, his formula may be correct for ordinary purposes.

The writer has used a 40-inch cupola for five years on ordinary work, with the top tuyers 26 inches from the sand bottom, and has always found it necessary to use from 1,100 to 1,200 pounds of coke for the bed, as the quality of iron desired demanded, and in heats of 15 tons melted at a ratio of 1 to 12 the charges were 2,500 tons each, and fuel used between them varied from 100 to 150 pounds, according to weight of iron melted. This is simply given as an example to show how far we may depart from what one individual finds successful and still produce good results. The cupola mentioned melts at the rate of 8 to 9 tons per hour.

However, there is one point in Mr. Grindrod's article that does not bear his theory out according to the figures he gives. He states a 30-inch cupola with tuyers 12 inches from the bottom requires a bed of 450 pounds of coke, and a 42-inch cupola with the same height of tuyers 630 pounds. Now, assuming that a 30-inch cupola has no more height of fuel above its tuyers than a 42-inch and the assumption is safe there is an apparent mistake some place. The 30-inch cupola contains 707 square inches of area, the 42-inch 1,385 square inches—almost double—and the area represents the capacity. His ratio in the 30-inch shows .63 of a pound of fuel per square inch of radial area, while in the 42-inch it only shows .45 of a pound per square inch, and in a 72-inch cupola the formula would read thus: 450 multiplied by 72 and divided by 30 equals 1080 pounds. This amount of fuel in a 72-inch cupola would only fill it a little over one-third as full as the 450 pounds would the 30-inch. Making the radial area only represent .24 of a pound of fuel per square inch, and this amount of bed in a 72-inch cupola we know is impractical. On his basis of 450 pounds for a 30-inch, the 42-inch cupola, in proportion to its area, would require 872 pounds and the 72-inch 2,564 pounds. The formula for charging is equally erroneous as regards the 42-inch. Take the two capacities of the 30-inch to hold 1,000 pounds of iron per charge, the proportion that should go to the 42-inch per charge would be 1,952 pounds instead of 1,400 as Mr. Grindrod gave it. There is also another item that regulates the best result in charging. Blast pressure determines what weight the charge should be, but this can only be ascertained by constant experience in each individual cupola. The higher pressure used, the greater should be the charges of iron and coke, while the lower the pressure the smaller. The reason for this is obvious: with the high pressure the blast is forced to a greater height, and the flame and intense heat covers a greater perpendicular area in the cupola, and to get the full value of it the charge must nearly occupy the distance known as the melting point. If high blast is used, and small charges, the flame is forced entirely through the charge of iron and consumes part of the fuel in the succeeding charge before it arrives at the melting point, which is always done at a loss of fuel, while the other side of the question is also detrimental to large charges and low pressure. In this case the blast does not force the flame far enough, and the first part of the charge will melt hot and the last dull, causing irregular melting both as to time and quality of iron.

Mr. Hansen, in the April FOUNDRY, on "The Blast Meter," gives some valuable points regarding its use and what is often

expected of it, and his statements as regards Positive Pressure Blowers are undoubtedly correct; but when blowers of the Sturtevant or Buffalo type, or fans, as they are sometimes called, are used, his opinion regarding its use is unquestionably at fault, and think the assertion correct that the major portion of our foundries possess this style, although the positive blowers are widely used. With the positive blower, as Root's for an example, which positively discharges so many cubic feet of air per minute, there is no doubt but that the revolutions per minute are the most reliable guide to ascertain the amount of air delivered over the blast meter, and that the pressure would undoubtedly rise with finer material or clogged tuyers. But with the Sturtevant style of blower this is not true, for the pressure acts in a different manner. The air from this style of blower derives its power or pressure from centrifugal force, and the speed of the blower determines that pressure. Assume that a No. 8 Sturtevant is run 2,500 revolutions per minute and produces a pressure of 12 ounces, when the cupola is in operation, if half the tuyers, or even all of them, were suddenly closed the blast meter would show no increase in pressure if the engine governor maintained the blower at a uniform speed. The speed of the blower represents the pressure, the horse-power required to drive it, the volume; whereas, with the positive blower, the speed represents the pressure and volume. It is true with the Sturtevant blower, the larger the outlet the greater volume of air will be delivered at a given pressure and speed, until the full capacity of the fan is reached; but as the volume is increased the horse-power required to drive the same is increased, and if the pressure diminishes you will ascertain the speed of the engine has also diminished or the belts slip. If the wind-gate is shut while the blower is running, the engine will show its relief instantly, and its speed be accelerated noticeably until controlled by the governor. A No. 8 Sturtevant blower can be run to 14 ounces pressure with a smaller engine or less steam when it only has to supply for 6"x6" tuyers than it could with twice that number. These facts show that the speed of the fan regulates the centrifugal force, and when the resistance at the tuyers increases it balances this force and only accepts the amount of air that is consumed at that pressure. For this reason the blast meter is a true guide when used with this style of blower, and is superior to a speed indicator on the engine, in that it shows the minute the belts begin to slip. The writer has used a blast meter the past five years, and always found its record accurate and reliable above everything else connected with the cupola.

Mr. Sorge also contributes an interesting little article to April FOUNDRY on atmospheric influence on the melting of iron, and while it may be figured out by chemical formula it does not hold good in actual practice. Contrary as it may appear, on a wet, rainy day, or when a snowstorm is in progress, iron will melt hotter and often with less fuel. This is a well-known fact, and every practical foundryman who has constant dealings with cupola practice, will bear the assertion out. It appears that the introduction of hydrogen in the form of moisture in the air has some powerful bearing on the action of the cupola, for fuel has been reduced 15 per cent on a rainy day, and equally good iron as on a bright, clear day with the normal amount. This has been repeatedly demonstrated. There is a firm in East St. Louis that uses super-heated steam, blown in the tuyers of the cupola, and claim good results; also wetting fuel is sometimes practiced, but with what actual success the writer is not prepared to say.

However, actual experience has taught that in good cupola practice—by that it is inferred melting at a ratio of 1 to 12—the difference in temperature has no visible effect upon the melting operation, though the temperature may vary 80 degrees, but that moisture in the atmosphere is positively an assistant to the process. This may not be chemically or satisfactorily explained, yet it is actual practice.

Heavy Engine Bed in Green Sand.

Our illustrations show an engine bed for a 50x26x28-inch Corliss engine, now being erected at the works of Knowlson & Kelly, Troy, N. Y., for the Albany Electrical Railway power station. The castings were made at C. F. McMurray's Center Island Foundry, Troy.

The illustrations give two views of the

first of the two beds required, each of which will weigh 22,000 pounds, and were made in green sand with the exception of the center, for which a plate was made and lifted out 16 inches on the inside. This was skin-dried to prevent scabbing.

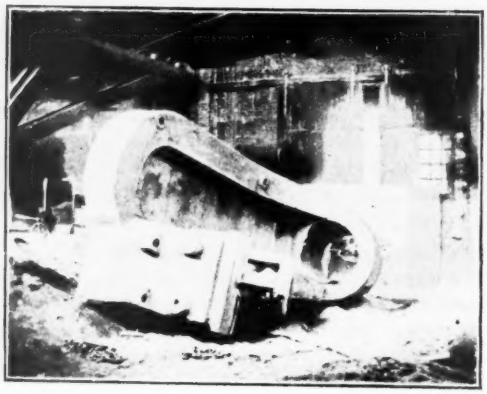

FIG. 1.

It was poured with three ladles, one on the bottom of the pillow block shown in the foreground at Figure 1, one on the large round end at the bottom, and one on the top, this latter having been poured after the casting was nearly full on top, as shown in Figure 2, which is really the bottom, as the

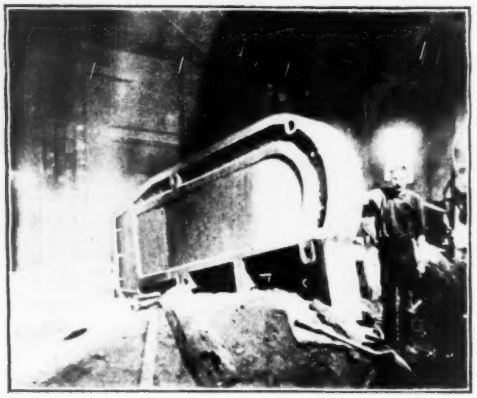

FIG. 2.

casting where the engine bed is set up is not very heavy, but has to be solid in order to hold the oil that may drip through.

Those who were engaged in making this casting have reason to feel proud of it, as it is said to be a very excellent piece of green sand work.

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*How to Turn Out Good Molders.

I have been asked to give my ideas on the subject "How to turn out good molders."

I cannot say that I have ever favored or practiced any fixed system which had this object in view, excepting to encourage good boys who showed intelligence, and were hardworking and painstaking. My actual experience has been confined to one foundry in which I have been successively, apprentice, journeyman and foreman, and any observations noted herein are produced from many years' participation in the business in those capacities. The foundry in which I have acquired my experience has, during all these years, been able to command a class of business of great variety and high character of requirements, and therefore apprentices and journeymen have had exceptional opportunities for advancement and improvement.

The art of "molding" is very ancient and many men have been engaged at it, all the good ones recognizing the fact that there was room for improvement, and that they individually could always learn something more about it. The best way to turn out good molders, I should think, would be to encourage the good, the intelligent and the industrious boys, and, after a fair trial, dismiss the incompetent and idle ones. Those of the latter class should seek fields where hard work and intelligence are not so largely required and seriously needed. Boys who are not fitted for the trade, but who are anxious to get along, should be advised and helped to secure a trade of a different character and more in keeping with their peculiar fitness. Boys who are indifferent, idle and incompetent, should be dismissed, for the reason that the molding art requires, for successful attainment, the reverse characteristics. When a boy is not adapted to the trade for various reasons; when he is naturally incompetent, idle or vicious; or when he is not so inclined, but is kept at it by parents or guardians, and perhaps, if he had the chance, would adopt another calling, he should not be encouraged to continue an apprenticeship which could not result in any

*Paper by D. J. Matlack, read at the May meeting of the Philadelphia Foundrymen's Association.

benefit to either himself or his employer. It is not always easy to make up one's mind to discharge boys who do not fit the business, and I will admit that I have not always practiced what I am preaching. But I am convinced that in all such cases I have erred by reason of mistaken kindness or unwillingness to possibly harm the boy, or disappoint his relatives or friends for whom I had a kindly and a closer feeling.

For the good of the trade and the business, as well as for the ultimate benefit to the boy, I believe that fitness, industry and intelligence only should be rigorously recognized. Intelligence and education are always great helps to boys in this as in any other calling, although our most intelligent and better educated boys generally develop into employers of some description. I have noticed that those apprentices who have developed into first-class molders have been successful mainly by reason of their own efforts, application and natural ability. It has been the rule in our shops that a boy should have the opportunity to so advance, and the same fact I suppose holds good in any other shop or trade. The best and most intelligent boys generally develop into something better than good molders. Some become proprietors of foundries, others become foremen, and there are still others who engage successfully in business of a different character. Sometimes they stick to the trade, but, as a rule, brains and education will not be confined to simply becoming a good molder.

I have always believed in affording opportunities to apprentices who have evinced a disposition to take advantage of them. Any of our apprentices who are careful, painstaking, hardworking, and who also possess adaptation and inclination for the business cannot help finding the way, means, and opportunities necessary to make them good molders. If they remain with us after reaching their majority, the improvement is sure to go on for the reason that our business has always covered such a large variety of the highest character of castings. This must have been so, as shown by our men being in demand all over the United States, not only as journeymen, but also as foremen, and quite a number have engaged in business for themselves.

It is the rule with some establishments, including our own, that a portion of the wages of the apprentice shall be withheld and given to him in a lump sum at the expiration of his apprenticeship. This practice may be advantageous to both the boy and his employer in some ways, and I will not record myself as definitely either opposed to or in favor of the practice. I will only say that I cannot see that it operates to the advantage of the object to be gained—"turning out good molders;" for while it may have some slight effect in holding the good boy to the trade, it would also operate against the inclination of the employer to get rid of the incompetent boy, thus saving to himself the accumulated wages of which the boy will be deprived.

Any rule, practice or system inaugurated with a view of improving the grade of molders will to a large extent fail if the principles I have tried to explain are not given due consideration. Good apprentices will make good molders, and the larger the variety and higher the quality of opportunities given them, the better will be the results as to the ability of the molder turned out.

Philadelphia Foundrymen's Association.

The sixty-first meeting of the Foundrymen's Association of Philadelphia was held at the Manufacturers' Club in that city on Wednesday, October 7th, 1896.

The chair was occupied by President Francis Schumann. This being the first meeting since June, the attendance was fairly large.

The meeting dispensed with the reading of the minutes of the last meeting, and proceeded at once to business.

Secretary Howard Evans presented the report of the Executive Committee, which was as follows:

Your committee would report that this the sixty-first meeting is the first one since June. There is very little to report, except that there has been a general depression in the foundry business during the summer months. At this time, however, there is a decided improvement, for what reason we do not know except that stocks must be renewed or that the uncertainty regarding election has been entirely eliminated and that the better feeling is brought about in the assured election of McKinley, which will bring with it settlement of the money question. It will also

bring about a feeling of confidence and money which is now lying in banks and other depositories will be put into circulation helping all lines of trade. We know of one large contract for iron work that was countermanded until after election. It is understood that the contract will be given out if McKinley is elected. It amounts to a million dollars and will, therefore, assist the working man and the foundry and machine shop, etc.

This is only one out of a number of contracts in this section that have been countermanded. We are, therefore, looking for better times.

Reports from the various sections of the Price Committee were next called for, but the only response came from the Cast Iron Pipe section. P. D. Wanner, of the Reading Foundry Co., Ltd., Reading, Pa., the chairman of this section, made the following verbal report: "I have nothing to say, especially regarding the foundry trade. I am sure we cannot report anything more favorable than we have been reporting for some time previous to this meeting. We are all living on hope, and it seems to me that nearly everything is put off until after the election, in other words, depends upon the result of the election. The pipe trade is exceedingly dull. Our foundry has been closed for some months and we have a large stock on hand. Some of the other foundries are going ahead partially, but I do not think any of them to-day are doing what you might call good business, and prices are anything but remunerative. That is really all I can say on the subject. I might say a few words on another subject which, I think, will not be against the sentiments of the members of the association. The election to be held on the 3rd of November will be likely to decide some of the most important questions ever submitted to the American people. Never did the men of the industrial, commercial, financial, transportation and general business interests have such issues at stake,—not only the maintenance of an honest and efficient financial system, but the right to property and the preservation of constitutional liberty. The dreadful consequences that would inevitably follow the election of Bryan, and the triumph of Populism would not seem to have been fully comprehended by our patriotic people. Will they be equal to the emergency and save the country, or shall it pass through a violent revolution with all its fearful disasters, and finally emerge as a strongly centralized and arbitrary government? These are vital questions. As business men many of us have, for years, failed to do our duty as citizens in our anxiety for success in our respective business callings. We had no time for politics, and yet some of us were patriotic and brave enough to endure the hardships of the field, face the bullets, bayonets, and the cannon's mouth, while others languished and starved in prisons to save the country and uphold its honor and the "Old Flag," but in days of peace had no time to attend a primary election, or courage enough to face the ordinary ward politician and agitator. As a result, this class too frequently had their own way, and now have involved the whole country in this dangerous struggle. There are exceptions, but as a rule the element arrayed with Bryan against the best interests of the land for its overthrow are those who could have been influenced and probably controlled by the men of affairs who employ so many of them if they had been attended to earlier, but who are now told by Bryan that there must be no intimidation, and that the captains and generals of the great industrial and commercial establishments dare not do anything to persuade the men in their employ to vote for the mutual benefit of both, while he has, probably, all his expenses paid and his whole campaign upheld by one of the most nefarious combinations that ever cursed this land—the silver trust, which has held up by the throat, as it were, the business of the whole country for the last three years and would overthrow it for their own profit. While Bryan talks for them, and a fifty thousand dollar salary for himself, he offers to the American workingmen a fifty-cent dollar, and common ruin to the whole country. We hope, in the providence of God, that the dire consequence alluded to may be averted and the country saved once more. And if so, it should still afford a most instructive lesson to all the business men throughout the length and breadth of the land to take, in the future, more interest in their government, and not leave all that to the politicians, office-seekers and agitators of socialistic and communistic views."

Mr. Wanner's address was listened to with much interest and ended amid applause.

The chairman announced that the next business in order would be the nomination of officers for the ensuing year.

After some discussion and the nomination of several gentlemen who were not able to serve, the following were selected:

President, P. D. Wanner, Reading Foundry Co., Ltd., Reading, Pa., Cast Iron Water and Gas Pipe, etc. Vice-President, Thos. Devlin, Thos. Devlin & Co., Philadelphia, Hardware and Malleable Iron Castings. Treasurer, Josiah Thompson, J. Thompson & Co., Philadelphia, General Foundry and Machine Shop. Secretary, Howard Evans, J. W. Paxson & Co., Philadelphia, Foundry Facing, Sand and Equipment. Executive Committee—Walter Wood, chairman, R. D. Wood & Co., Philadelphia, Gas and Water Pipe and Hydrants; Thos. Glover, Glover Bros., Frankford, Philadelphia, Hardware and Small Gray Iron Castings; E. E. Brown, E. E. Brown & Co., Philadelphia, Sash Weight Castings; Stanley G. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia, Hardware and Malleable Iron Castings; Wm. F. Sauter, G. Rebmann & Co., Philadelphia, General Foundry. Ex-Officio: P. D. Wanner, President; Howard Evans, Secretary.

The matter of the unused balance of the money raised to entertain those who attended the meeting held in Philadelphia in May at the time of the formation of the American Foundrymen's Association was then taken up and after some discussion a motion was made that the amount, which was $1,154, should be turned over to the treasurer of the Philadelphia Association and was carried.

THE CHAIRMAN: The next business is the reading of a paper by Mr. Geo. C. Davis, chemist to Thos. Devlin & Co. Mr. Davis then read the following paper on

The Analysis of Coke.

I am somewhat afraid that Mr. Evans has overestimated my ability as a teacher, for I see by the programme that I am expected to teach foundrymen how to make their own coke analyses. You will all agree with me that no more apt pupils can be found, but the necessary knowledge of chemistry and skill in handling the apparatus can only be acquired by study and practice. It is well for the foundrymen to take heed of the old saying: "Let the cobbler stick to his last," and when any question of chemistry comes up it is the best way to consult a competent analyst.

Coke plays so important a part in the production of iron and steel in all stages of the process, and may so largely affect the quality of the product that it becomes almost a necessity to be able to determine upon its suitability for use in blast furnace or cupola. The furnace manager wishes to know the percentage of sulphur and phosphorus present, as well as the amount and composition of the ash. In a blast furnace practically all the phosphorous from the coke is found in the pig metal. As coke often contains .02 per cent of phosphorous and as about a ton of coke is required to produce a ton of pig, it follows that the percentage of phosphorous will be increased by the amount found in the coke. You can readily see that in the production of Bessemer or malleable iron this becomes an important matter. In the cupola the conditions are different. Let us assume that it requires one pound of fuel to melt seven of iron. I know that my placing the ratio of iron to coke at 7 to 1 will be criticised, but I am convinced that this is nearer the truth than the 16 to 1 ratio we hear of from some foundrymen and politicians. Assuming our coke to contain .03 per cent phosphorous, which is higher than any sample I have ever analyzed, it follows that the percentage of phosphorous in the pig would not be increased more than .004 per cent. So small an increase as this would be of no importance even in malleable work, and as I am speaking to-night with especial reference to foundry practice, I think we may eliminate the determination of phosphorous in coke from among the numerous things the foundryman has to worry over. In furnace practice the composition of the ash becomes an important matter. As the slag should only vary within narrow limits, it is necessary to determine the amount of silica, iron alumina, lime, and magnesia which enables the furnace man to add enough limestone to produce the desired result. In the cupola the amount of slag is small and may vary widely in composition provided it is fluid. Except in long runs in large cupolas, the slag is not tapped out and little attention is paid to it. In fact, I am afraid that many small users of iron omit the limestone altogether and the result is often a badly stuck-up cupola, which requires some time to repair, when a few pounds of limestone would have prevented

the trouble. The usual practice is to add from 20 pounds to 40 pounds of limestone per ton of pig. This amount is ample to flux the sand adhering to the pig and to supply any deficiency of base in the coke ash. We conclude, therefore, that it is the amount of the ash that is of most importance to the foundryman and it is the so-called proximate analysis of coke that I shall describe to you. To carry out the complete analysis would require several hours, which I know is more time than you would wish to spend in simply watching mere drying or ignition of the sample, which is often slow work. I have chosen, therefore, to show some of the apparatus used, and the analysis of the sample at different stages of completion, by which means I hope to make myself clear. In work of this kind it is very important that the conditions should always be the same. The necessity for this is still more marked in soft coals, when a slight change may produce a large difference in results; but for sake of uniformity we heat all samples of fuel under the same conditions. To determine the moisture, from one to two grams of the finely powdered sample is weighed out into a platinum crucible and dried for one hour at a temperature of 100 degrees to 105 degrees, in an air bath such as I have before me. While this is being done, another sample is weighed into a platinum crucible and ignited for three and a half minutes over a bunsen lamp, and then for three and a half minutes over a blast lamp. After cooling in a dessicator and weighing, the loss is calculated as moisture and vol. combustible matter. In a like manner our first sample gives us the moisture and by subtraction we find the p. c. of vol. combustible matter. The second sample is now ignited until all the carbon has burned off, when by again cooling and weighing we have the ash. By adding together the p. c. of moisture, vol. combustible matter, and ash, and subtracting from 100 we have the amount of fixed carbon. The time of ignition, seven minutes in all, in determining the vol. matter, was fixed some years ago by the chemist of the Iowa State Geological Survey by a series of experiments, and has since been adopted by nearly all the chemists in this country. Unless the coke has been carelessly made the amount of vol. matter will seldom exceed 2 per cent. I recently had a sample of poor coke containing over 4 per cent vol. combustible matter, but this was exceptionable. Such coke has a tendency to burn out quickly in the upper part of the charge, but this phenomena is much more noticeable in a blast furnace than in a cupola. It does not always follow that a coke lowest in ash is the best. I have noticed that the purer cokes are often weak and crushed easily, while those containing an average amount of ash, say 8 per cent, gave much better economy, as there was less loss in braize. This, however, is a matter that has to do with the physical rather than the chemical examination.

For determining sulphur there are two methods, and the one I shall describe, which is probably the more often used, is known as the Eschka method. We take 1 gram of coke, and after mixing well with 1½ grams of Eschka mixture, which contains 2 parts calcined magnesia and 1 part of dry carbonate of soda, transfer the whole to a platinum crucible. About ¼ gram more of Eschka mixture is poured on and the crucible inclined on a triangle. Heat is now applied rather slowly at first and in the course of an hour the coke will have burnt off, leaving all the sulphur present in combination with the soda. The process is hastened by frequent stirring with a platinum wire. After cooling, the crucible is placed in hot water and kept warm a few minutes. The magnesia is insoluble while the sodium salts pass into solution. By filtering we get rid of the magnesia. To the filtered solution is now added a little bromine water, and 3 centimeters of hydrochloric acid. The bromine insures the complete oxidation of the sulphur to sodium sulphate, while the acid decomposes the excess of sodium of carbonate present. The solution is now concentrated by boiling; the excess of bromine and carbonic acid gas passes off and we are now ready to throw down the sulphur, as sulphate of barium, by adding a soluble salt of barium. The barium sulphate is a heavy white precipitate, and settles to the bottom of the beaker. We now filter off the precipitate and wash with hot water, place filter and precipitate on a crucible, and heat gently until the filter is charred. By increasing the heat the filter is burned off, while the barium sulphate, which contains 13.76 per cent sulphur, remains. After cooling in a dessicator the precipitate is weighed and the p. c. of sulphur calculated

as usual. In coals sulphur exists in combination with lime as gypsum, with iron as pyrites, or with the carbon compounds as organic sulphur. In the process of analysis part of the sulphur is driven off with the vol. matter, part with the fixed carbon, while the rest remains with the ash. It is impossible to correctly apportion the sulphur among these, so it is reported separately. Coke usually contains from ½ to 2 per cent of sulphur. In the cupola a part of the sulphur is always taken up by the iron, but the addition of lime and melting hot have a tendency to prevent this, for at a high temperature lime has a greater affinity for sulphur than iron. Fortunately many of the West Virginia cokes run low in sulphur, .60 per cent and under, giving the foundryman a much purer coke than was formerly obtainable. I may add that the apparatus and chemicals for coke or coal analysis can be bought for $125.

Mr. Davis exhibited the apparatus used in the analysis, also the different solutions referred to.

MR. EVANS: I made the statement in the circular calling this meeting that the analysis would be made before the meeting, but I found this would take some hours, and Mr. Davis has explained as well as it is possible the process.

MR. THOMPSON: I move a vote of thanks be taken and tendered to Mr. Davis for his paper.

The motion was seconded and carried, and the thanks tendered to Mr. Davis by the chairman.

MR. DAVIS: I thank you. There is one thing I should state. I made the statement that the analysis took some time. Of course a chemist in working could look after a number of analyses. The delay arises when a solution settles very slowly. We frequently have to let solutions stand several hours.

MR. OUTERBRIDGE: Have you made any careful calculations as to the relative cost of using coke or anthracite coal in melting in the cupola?

MR. DAVIS: I have not. Such a calculation is a little out of my line—as where I have been connected it has not been practicable to use anthracite coal at all.

MR. SCHUMANN: Is it not a fact that coke has been more extensively used in consequence of the inequalities in coal, more than the difference in cost?

MR. OUTERBRIDGE: I do not think so.

MR. SCHUMANN: Expressing my experience, we came to use coke because we could not get good coal. We began mixing our charge one-quarter coke until we finally used nothing but coke. This was due largely to lack of good coal.

MR. DEVLIN: I think one of the chief reasons for using coke is its quick melting qualities. We find we can melt in 35 per cent less time than with the best coal mined. For that reason, and that alone, we use coke.

MR. WHITNEY: That is why we use it. We always use coal in the bed, but coke in the charges.

MR. CARLTON (of the Pratt & Whitney Co., Hartford, Conn.): I have used coke for several years in part, but never as a general thing entirely. I have found in my practice that I could do better with part coal than with all coke. I do not know that one has any advantage over the other in getting good castings. I use coal on the bed and on all the intermediate charges.

MR. SCHUMANN: For the last eight years we have burned nothing but coke, both for the bed and through the charges. One cupola is 18 inches, another 48 inches and another 60 inches in diameter, and we make castings running from 100 to the ton, up to 20 tons each. We have made plates ¼ inch thick, 62 inches wide and 17 feet long, and the same cupola melted the iron for castings weighing 20 tons. The efficiency of coke cannot be denied with such results. To run a large plate we must have hot iron. As I have said before, we used to use coal. At that time we had a contract for making wire benches, and these usually, as you probably know, are 18 inches high, 14 inches wide, and are very thin. These we made from our standard irons, and cast ahead for the convenience of our machine shop. The coal was of such a nature that the castings could not be touched with our ordinary tools in the machine shop. We first accused the pig iron men, but we were afterwards convinced that it was due to the coal.

MR. MOORE (Elizabethport): I would like to hear a discussion on "Cost of Castings." I would also like to know whether anyone

here has had experience with a center blast cupola.

MR. CARLTON: I used one, but took it out. Not because I did not like it, but because the furnace was not large enough.

MR. MOORE: Would a 78 inch cupola be large enough?

MR. CARLTON: Yes.

DR. KIRK: I have had no experience with a center blast cupola. I have heard of the cupola and been to see it, but everywhere I went to see one I found it out of order. That seems to be the great objection to it. Great advantages are claimed for it in point of economy. I think a center blast could be used to advantage in a large cupola, but I don't think it could have the advantage in a small cupola.

MR. CARLTON: I used my cupola a month with the center blast, but I inserted a 1-inch steam pipe through the center of the wind pipe to produce a gas. A trouble I experienced with the steam pipe, however, was that I could not get a material that would withstand the intense heat at the end of the charge. This heat would melt off my steam pipe. I never had any trouble with my wind pipe.

MR. EVANS: The Wilmington Pipe & Foundry Co., Wilmington, Del., use a center blast cupola. The proprietor says he gets very good results from it, but it gets out of order. They have a cap which goes over the center tuyere and a hole in the drop plates, and the central tuyere is put in position and held there. They have more or less trouble in keeping the cap in condition, and stopping the slag from forming around the openings to the tuyere. They have a small cupola, lining up to 35 inches.

The question of low prices coming up, Mr. Evans said he had been told that lower prices for castings existed in Philadelphia than in any other part of the country, the same ranging from 1¾ to 2 cents for machinery castings.

MR. SCHUMANN: Are there not more foundries in Philadelphia than in any other part of the country? That may account for the competition. I would ask you, Mr. Moore, whether, in determining the cost of the castings, you keep the time of the molders?

MR. MOORE (Elizabethport): Our first cost is the cost of the melted iron in the ladle, then the cost of the molder, and the other labor is taken.

MR. REBMANN: Most of our work is piece work. We can figure the cost of the iron, and the attending costs, and get pretty near the general cost. We count the cost of the mixture, of course, first.

MR. SCHUMANN: We have attempted for the last six or seven years to find out what castings cost us. We keep the time of the molder on every job he does. We know the weight of the casting, how much sand we have during the year, how much coke, sand, etc., is used, how much molasses, flour, and core sand is used, and how many shovels and sieves are used. We have the time of the cupola attendants, sand-mixers and foremen. In all there are, I think, about 15 items to count in the cost, and it varies from 1 32-100 of a cent to a shade over 2 cents exclusive of melting. The melted iron runs up to about ⅞ cent. Leaving off the shovels and sand, etc., you get the cost. Has it ever occurred to any of you that the quality of castings has deteriorated? There is a great deal of carelessness in the general finish, etc., which may explain the low prices.

MR. DEVLIN: I heard this same talk of cost forty years ago, and it was then said that it was impossible to make castings at the price they were selling for. I hear the same thing to-day, but I do not hear of any foundries going into bankruptcy. The question of cost is a very difficult one to arrive at. I think it is almost impossible, for various reasons. For instance, we have castings weighing from 25 per cent to 75 per cent in gates, etc. We may probably have to melt over three or four times. It is hard to get castings always right. We keep account of all the material we buy for a year, the pig iron, coal, coke, and everything that enters into the melting of iron. We know how much the iron costs, and the different materials, sand, labor, and so forth for a year, and we take an average, making a cost per pound. All we have to take into consideration in a job is the labor of molding. We therefore know pretty well what it costs before we take a job. The molding is the only thing we do not really know the exact cost of, and we have to figure as best we can. We generally get a pretty accurate estimate before we cast. I think a system of

this kind enables anyone to give a reasonable price before a contract is taken.

MR. MOORE: A system of that kind works pretty well in a business like Mr. Devlin's. In our business it would be a difficult thing to establish a cost on a year's basis. In our business one class of work costs much more than another.

MR. SCHUMANN: I might call the attention of the younger men in the business to an interesting problem. There is a relation between the cost of molding a casting and the volume of sand that forms the mold. Suppose your flask contains a cubic foot of sand and the volume of the casting was, say 10 inches, and the volume of the void 20 inches, the difference being made up in cores and one thing or another. There is a certain relation between those three elements and the cost of molding, when you speak of green sand molding. The same thing applies to loam castings, but better to the green sand castings.

The meeting then adjourned.

Pokey's Pointers.

"Tom Bowers, I am glad to notice that you have got the men to exert themselves a little bit. We have all got to scratch more or less nowadays, and you know what I have said to you several times, that unless a man keeps pushing those in his employ, they will drive nails into his coffin."

"And if he don't know where to stop his pushing," returned Tom, "they will use screws instead of nails."

"Sounds just like you, Tom. That is the only objection I got to you. You lean a bit too much toward the men. But you must have looked rather hard at them here lately," Pokey went on, "judging from what they have got on their floors this morning."

"I don't think I have," answered Tom.

"Well, Tom, if you haven't looked at them from a sound money basis, you have given them the best talking to they have had for many a day."

"Haven't said a word to them outside of the usual," answered Tom.

"You haven't looked at them, nor talked to them, raised their pay or swore at them and still they are doing more. There is a pointer concealed at the bottom of this some place. Why, Tom," and Pokey gave a start as if he had stepped on some hot scrap, "there is old Dick Williams, has got up four of those heater bases."

"Yes—"

"Don't say a word till I tell you," Pokey interrupted. "That job has been in the shop thirty years, and we never could get a molder to put up more than two of them. My father got his head set once that he was going to have three for a day's work or bust and he came near busting. You know yourself that there was no money in the job, and the only reason we kept it was to keep the shop agoing when other things got slack. Well, my daddy, you know, was a great hand to tear around, always believed in having things run steady by jerks and jerking it was from one end of the day till the other. He had everyone in the shop try his luck, as he called it, on these bases and when every molder had failed to make more than two in a day, he made the fireman pull off his coat and take his turn, just to show what he was good for. He only got up one and the old man fired him. Sent to New York for a man who had a pedigree a rod long for being a driver and he drove a good many gray hairs into the old man's head and got five dollars a day for doing it, but still there was only two bases on that floor at casting time. Then the old man thought he had found the key to the situation; the molders' union was preventing the men, so he thought, from doing what they could. He spent five thousand dollars in filling his shop with men who owed allegiance to nobody but Pokey and still the result remained the same. A month ago we got two, to-day we get four of these castings from the same man; now Tom, just let me know how this thing is done and I only wish the old man was here, how he would take it in."

"The old flasks gave out," Tom began, "and—"

"How could they give out?" interrupted Pokey. "They had iron bars."

"Yes, and wooden sides," added Tom. "The poorest combination that can be made in a flask. The gases find their way through the bolt holes and every time they are used you are taking so much of their life away. The fire burns them alongside of the bolts and the washers stops you from putting it out. Another thing you want to consider is that all iron flasks are not good flasks. You can make an iron flask just as clumsy

and unhandy as you can a wooden one. Now when those bars were made some molder leveled up a bed, and with the help of a two-foot rule, a gate cutter and a few broken stock cores, managed to get something that resembled a bar, made them without a pattern, too, and probably thought he was doing a good job."

"They answered the purpose, didn't they?" asked Pokey.

"Yes, just enough so that you never could get more than two bases a day," retorted Tom. "It is one of the great vices that foundrymen have, this thing of getting along with something that answers the purpose. There is nothing too good for the foundry, just keep this in mind when you are thinking about making improvements. Let things that answer the purpose be fired in the cupola and substitute others made to fit."

"Don't get mad, I want to find out how Dick Williams come to be doing double the work he used to."

"He ain't."

"Is that so? Now look here, Mister Tom, no more of your joking pointers are going to be digested by me. They form an unwholesome diet and have the habit of coming back again. May be, before I get through with you, you will tell me that Williams ain't doing as much work as he used to?"

"He ain't."

"Didn't I tell you that was what you would be saying next, Tom. It will be in order now for you to tell me that all Williams has got in those boxes is, what is it the boys call it, when a molder fills up a flask and drives a gatepin down to make someone think that he has done a big day's work?"

"There is nothing counterfeit about those flasks," answered Tom. "But Williams ain't doing double the work nor as much as he used to. Your dad worked on those lines, he couldn't see how a man's output could be increased without doing more work. Now, here are the facts, a man is producing twice as much with less."

"Go on, Tom, let us have the solution to the riddle. You said you made new bars, but the old bars were new once and we never got any more from them."

"New such as they were. There are some new things never ought to have been made. Many a new flask is worse than an old one from the start. With those in question the molder had to do as much work as if he had some old wooden flask, had to put in blocks to hold his core up, set gaggers here and nails there, and mind you, all of this with a flask that was supposed to be built just for the very job. When the mold was closed it was mud up here and fasten a chaplet there, enough tail end ceremonies to take up an hour. When I seen that we had to make new flasks I made up my mind to do away with all this waste of time. Our work only amounts to something when it is effective, and of the amount of hard work that is thrown away and actually non-productive in a foundry, well, Tom Bowers knows of quite a bit. I got the pattern-maker to make patterns for these flasks and —"

"That costs money, Tom, they are high-priced devils. You get ten dollars worth of work from them and you have got nothing to show for it."

"It does cost money," said Tom. "But now, you wouldn't think of asking Widbur, when he wants a drill chuck, to come out here and have it made in open sand without a pattern?"

"But that is different, Tom."

"Yes, because you have been brought up to look at it that way. What they want in a machine shop is things that fit, they get it because they refuse to get along without it, and practice has proven the economy of exactness. Just grant us the same privilege here and may be there would be a change. It isn't what money you pay out that counts, but the net profit that tells the story."

"Net profits, Tom, that is it; that is what I am after. You manage to inflate those nets and we won't quarrel over what has to go out. And by the way, I do think that I am beginning to see that pointer of yours coming through. There are more ways than one of increasing a man's output without jacking the man up."

The foundry at the Washington Navy Yard is being rebuilt on a more elaborate scale and equipped with some of the necessaries for doing that class of work more economically.

The Institute for the Home Study of Engineering at Cleveland, O., have sent us their new catalogue and prospectus. This school pays especial attention to electrical subjects in addition to those that ordinarily receive attention at institutions of this kind.

A TECHNICAL JOURNAL DEVOTED TO FOUNDRY INTERESTS.

THE FOUNDRY

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THE FOUNDRY is issued promptly on the 20th. of each month, and will spare no endeavor to furnish valuable news and information to those interested professionally or incidentally in molding, melting, mixing of metals, foundry management, etc. Persons connected with any of these lines of industry will confer a favor upon the Editor of this Journal by sending him news from their section of the country pertaining to the foundry interests, particularly individual theories and experiences of practical value.

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Trade Outlook.

Business generally is in the condition reported for the past two months and only those castings are being made that are indispensable to the users. The cutting off of everything in the way of stock, the shutting down of thousands of pieces of machinery, closing up of hundreds of factories using machines, etc., has reduced the quantity of iron melted to a very low amount.

There is, of course, a better feeling prevailing, whether it is owing to an increased degree of confidence that the result of the election will be satisfactory to those who control the great business interests or whether it is that Americans generally are beginning to take a more optimistic view of the future and are learning to believe that this great country possesses too many sensible people to do anything to bring national dishonor, discredit or prostration to its business interests is a question that is really immaterial.

There is every evidence of a much better feeling on all sides, and while it has not yet reached the foundry business to any great extent its presence is being felt in many quarters.

The speculative movement in pig iron seems to be in a quiescent condition, but a great many foundries have laid in a good stock, in anticipation of considerable business, and in order that they might have the benefit of the present low prices.

Pipe foundries are experiencing a more severe depression than at any time during the past two years.

The recent and present financial troubles have rendered it almost impossible to dispose of bonds and debentures and as a result large numbers of localities that have contemplated improved water service have been compelled to forego that luxury for the present.

Scrap Heap.

Before another issue of THE FOUNDRY shall appear this election will be over and the country saved.

* * *

We say "saved" advisedly, because we are loth to accept the doctrine of the paid calamity howlers that the election of his opponents

means that we go to everlasting smash in inextricable chaos and confusion.

* * *

We are told in this election (the same story has been repeated more or less at every Presidential election for nearly 100 years) that we are certain to go to ruin no matter who wins.

* * *

While we have not enjoyed much prosperity for the past few years and while a certain body of political economists are quick to trace this to our leaning towards gold and the other stand ready to prove that to our flirtation with the silver deity can be traced all our troubles, we want to remind our readers that it is a way we have every four years, and unless they are being paid to believe and shout such stuff just don't do it.

* * *

Please remember that we have a population of something like 70,000,000 people and that the great bulk of this number are patriotic Americans, who know a good thing and a bad thing when they see it. They are intensely interested—all of them—in having good times in this country, and while perhaps differing somewhat as to methods (or choice of weapons, so to speak), they will watch results very closely and the moment expectations are not being realized or the carrying out of a certain policy does not produce the desired effect, they will be heard from in no uncertain way.

* * *

Every once in a while some highly imaginative individual imparts the information to a spell-bound public that on a certain day of the week and month and at a certain hour of that day the world is coming to an end.

* * *

These cranks occasionally manage to surround themselves with some sort of a following willing to believe such wild-eyed predictions and who drop out of sight after the hour set for the event goes by without even a clap of thunder.

* * *

It is so in politics. We have these people with us now. They are making a lot of noise and disconcerting a lot of people, but, dear reader, take no stock in it at all. Do your own voting according to the dictates of your own conscience. Keep cool and frown down any attempt on the part of others to predict awful disaster.

Business is going to continue much after the same manner. This is the most glorious country on earth to live in and it is going to increase steadily in prosperity and power.

Krank's Korner.

That castings can be bought cheaper than they can be made is a favorite preface for an exchange of ideas when two or more foundrymen meet and feel that their grievances must be let out some way. While it is undoubtedly true that some foundrymen can buy certain classes of castings cheaper than they can produce them, yet this is no proof that these castings are sold at a loss, for every one has an inclination to hold on to a thing until a small profit shall show itself before parting with it. Acting otherwise would only be an invitation to the sheriff to lend a hand. No enterprise stands without it is making a profit, and it is an every-day occurrence to see one make a profit where another would show a deficit—favorable evidence to the fact that this world is just what we make it.

* * *

In the middle of consolidation and concentration comes the cry of cheap things, no profits and everlasting perdition. When a manufacturer tells us that he can buy castings for less in the open market than his own foundry can produce them at, we seriously think that something is wrong, not with the shop that is able to make the low figures, but with the way the place is run that is being frozen out.

* * *

Most firms using any considerable amount of castings operate a foundry in connection. Some of these are money makers and others are putting gray hair in their owner's head. A foundry in such places becomes a sort of an appendix to a larger volume and is skipped over as unimportant. The firm who uses a reasonable number of castings should be able to outdo any jobbing shop on the same class of work.

* * *

It may at first appear as a "krank's" idea that a shop using, say, ten tons of castings a week, should be able to produce these at a less cost than what they can be purchased

for from a mammoth establishment. Contracts are taken pretty low, and where does the margin come in for a small shop?

* * *

The benefits to be derived from a small shop in connection with a manufacturing plant are manifold, nor does the question of economy need to be sacrificed for that of convenience. Speaking only of the ordinary run of castings, there should be a decided financial advantage attached to a firm producing its own castings.

* * *

There is no contract let for ninety-nine years in the foundry. If there was, there would probably be more money in speculating on future margins than in operating a shop. Contracts are only let for a limited time in any event. A jobbing shop receiving an order for fifty castings can with advantage furnish better appliances for facilitating the work than it could for six. If the order is increased to a thousand, still better methods may be employed, resulting in a lower cost per piece. And here is where the side show foundry, to use slang, should get in its licks.

* * *

Take, for example, Joe Johnson, who builds engines. He gets a set of castings made for a six by six, and the next week, when he wants a seven by seven, every flask is chopped out to take it in. The day after he must have another six by six, and there we are again, with more chopping and nailing.

* * *

Joe Johnson is one of these fellows who says he can buy castings cheaper than he can make them, and he is speaking the naked truth. He can do so because he goes at his own work as if he was running a jobbing shop and only wanted one casting of each pattern. If Mr. Johnson would make a set of flasks for his patterns, which he will use an indefinite number of times, his molders would be able to mold the greater part of the time, instead of doing a carpenter's work and spoiling good lumber, and Johnson would get his castings at a price that no jobbing shop would touch.

* * *

To one who changes from shop to shop it is surprising to notice the great number of foundries who do their own work on the plan of a jobbing shop. Take the machine shops of these same concerns, and new jigs for producing better and cheaper work are continually appearing, while the foundry is allowed to trundle along in its own old blessed way, while its owner is crossing himself and repeating the benediction that he can buy castings cheaper than he can make them.

* * *

To make cheap castings a shop must look ahead. When it comes to making patterns and shop rigging it should not be what we need to-day or next week, but what is going to be needed for a number of years that should determine what methods to adopt. The diminished cost of production will in itself tend to stimulate a demand. And no shop can look further ahead or feel safer in adopting the very best of appliances than the one doing its own work. To acknowledge that it can buy castings cheaper than it can produce them is simply an admission that there is something wrong with its internal affairs.

A Committee on Wind.

As an evidence of the trivial pretexts that occasionally mar the pleasant relations that should exist between employers and employes, we notice an item in the daily papers to the effect that the molders in a certain foundry in Belleville, Ill., went out on a strike recently because of the neglect of the company to furnish them with ice water.

This recalls to our mind an incident, or series of incidents, related concerning a certain well-known foundry in the State of Ohio a few years since.

It was said that the molders in the shop, under the leadership of one or two reckless, irresponsible, disturbing spirits, were in the habit of organizing "strikes" on the most flimsy pretexts and at about weekly intervals.

First of all, there was always trouble about prices whenever any new jobs were brought into the shop (where everything was done on the piece-work system). The foreman and shop committee would have a session, in which such a thing as an agreement was almost unknown.

If the foreman did not concede what the committee demanded the job would not be started, and if any attempt was made the

following or succeeding morning to put that particular job "on" one of the ringleaders would give the signal for a "shop meeting." These were usually held in the sand shed, the signal consisting of rapping quickly on a shovel with a piece of iron. As soon as this familiar sound was heard every molder would instantly drop his work and in a very few seconds the shop would be deserted, where before everything was all life and bustle.

Arrived at the sand shed, a hasty consultation was held among a few leaders and a sort of decision arrived at. Sometimes this took the form of appointing a committee to see the heads of the firm and give them to understand the lowest price at which it could be made. Perhaps the firm would say they could not pay it, and failing to agree a strike would result.

It was said that inside of a few weeks one season, when business was particularly good, the molders left their employment twenty-seven times. They had committees appointed whose especial duty it was to overlook almost every detail and section of the foundry business, and a day never passed without one or more of them calling on the proprietors for the purpose of seeing the adjustment of some real or fancied grievance. It is said that there was a committee on prices, whose mission was to regulate the price paid for work; a committee on weight shifting, to see that every man had plenty of assistance to shift his weights; a committee on new sand, to see that there was no want in that direction; a committee on bottom boards, to see that molders had a full supply and were not kept waiting; a committee to see that none of the men started before schedule time in the morning to work, and another to see that no advantage was taken of molders in the mill room by discounting too many castings.

One committee had power to enter a protest if they thought any of the men put up too much work, and another had something to say about the quality of the shovels, riddles, etc., supplied the molders.

Later on, when the weather got very warm, still another surprised the head of the firm in the office by advising him that they composed the committee on oatmeal and insisted that hereafter a proper amount of the ground cereal be furnished with which to flavor the ice water.

Exasperated to the last degree, the manager promised to do what he could for them, but with a resolution that if any more committees materialized he would either turn over the entire business to them and retire or fire them bodily from the office

Next morning, however, before he had time to comfortably seat himself at his desk, he was advised that another committee desired to see him, and upon his leaving his work in desperation to meet them he was told that they composed the "committee on wind," and had come to tell him that hereafter the blast must go on sufficiently early to enable all the men to shake out their floors, wet them down and get washed up before the whistle blew. Our friend, the foundryman, it is recorded, swiftly gazed at them with a crazed look of despair, promised to grant their request, and that night shut down his works for a week. When they opened again they ran for a week and shut down again. After trying this for a few times he was able to gradually resume control of his business, and tells the story substantially as the foregoing.

The Brass Founders' Supply Co., of Newark, N. J., formerly R. M. Barnett Co., have issued a very complete catalogue, containing in the first place tables of the various sizes of brass founders' flasks made by them with illustrations of the different styles and in addition to these are illustrations and descriptive matter of the different brass founders' furnaces and equipments handled by this firm.

As they are the largest dealers in this line in America and their brass foundry equipment is to be found in every state in the union this catalogue will be of great value.

A serious accident took place at the foundry of the Singer Sewing Machine Co., at Elizabeth, N. J., October 8th. From some cause or other the front of the cupola was blown entirely out, seriously injuring two of the molders. Fortunately the work of pouring off was nearly completed and but few men were in the vicinity.

Leavitt Brothers' foundry and machine shop at Salt Lake City suffered from a slight fire recently.

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

A correspondent writes, "You have said that the iron at the first of the heat was weaker and had a higher shrinkage than later on; that the iron at the middle of the heat is stronger and has less shrinkage than that drawn out first, and that the last iron has the least shrinkage of all."

In our cupola we do not get the hottest iron at the last end of the heat. We have put our poorest scrap in last, and have with this iron poured the castings that we are not particular about, but since we have used your test we find that the strongest iron comes at the last, where we supposed it was weakest. We now intend to put the poorest scrap in the first part of the heat.

Can you explain the reason for the variation in sharpness of the iron from one melt to the next without any apparent change in the conditions of charging or state of the atmosphere?

What can be done in the iron mixture to cause the sand to peel from the castings

Some years ago, I am told, that occasionally in one foundry an iron made from blackband ore was melted by itself, and that the sand did not burn on at all in those cases. The sample test bars that you sent me had no sand on them, and you cast them without facing. Do you use a mixture which runs fluid at a low temperature, for that is what the pig iron referred to apparently did? We cast seven half-inch test bars in each melt, and we can always get an average strength of over 400 pounds. The strongest average is 458 pounds, with extremes of 475 and 445 pounds. The shrinkage was .156.

We are using too much fuel, and I am going to try to decrease the height of bed, and increase the charges of fuel at the latter part of the heat.

ANSWER.—The temperature of the cupola itself increases from the beginning to the end of the heat. When the first melted iron falls onto the cupola bottom it boils on account of the moisture in the sand. This boiling continues until the hearth contains considerable melted iron, and until the surface of the sand bottom is thoroughly dry. The action is the same as when iron is caught in a ladle which has been lined since last used. The iron boils at the first catch, but lies quiet after the next catch, because the gases have been expelled from the lining. This boiling causes the iron to be weaker and the shrinkage to be higher than at a later part of the heat. The following analysis and physical tests of test bars from the first and the last ladle taken from the cupola show this to be the case:

TABLE NO. IV.

Chemical Analysis by CARY & MOON, of Chicago.	Total Carbon.	Graphitic Carbon.	Combined Carbon.	Silicon.	Phosphorus.	Sulphur.	Manganese.
First of Heat	2.910	2.280	0.630	3.220	1.025	0.123	0.490
Last of Heat.....	2.950	2.470	0.480	3.140	1.055	0.100	0.470

PHYSICAL QUALITY.	Tranverse Strength of Test Bar ½" □ x 12" long	Deflection. ½" □ bar	Shrinkage of ½" □ bar per foot.	Depth of Chill on end of ½" □ bar.
First of Heat.....	390 lbs.	.22 in.	.163 in.	.15 in.
Last of Heat	400 "	.22 in.	.121 in.	.07 in.

The shrinkage and depth of chill vary considerably while the chemical qualities are substantially alike. The boiling has apparently slightly diminished the carbon and has caused more to remain in a combined state. The first iron contained more silicon, which would ordinarily decrease shrinkage and chill.

The chemist was not able to discover a reason for the variation in combined carbon or the physical qualities. The change seems to be a mechanical variation in the arrangement of the grain. If the first iron is caught in a fresh ladle and then poured into another fresh ladle, the change above referred to increases until the iron often produces a white iron casting, which is very brittle and weak, with a shrinkage often as high as .225. Iron which melts half an hour after the first iron has come down will not show this high shrinkage and chill.

This explains why your first iron from your best pig did not give you as strong test bars as the last iron, which was chiefly scrap.

Scrap is not necessarily poorer iron than pig, but as the scrap pile is a mixture of castings made from different mixtures in different cupolas, the quality of the resulting castings is somewhat uncertain. If you make a mixture of scrap so that the grain of each charge shall average the same, the castings will be reasonably uniform in quality. If the castings at the last of the heat are satisfactory I would leave the scrap as at present and would increase the scrap at the earlier part of the heat. If the iron is not as hot in one part of the heat as at another, it is due to some local cause which can be discovered. The size of the fuel charges should keep the melting point the same distance above the tuyers. If the charges of iron hang up cold iron results when it drops suddenly, and if the air cannot get into the cupola during the last part of the heat on account of chilled slag the iron may not be as hot. The walls and the bottom of the cupola are at a higher temperature at the end than at the beginning of the heat. If the iron is not as hot one day as another, the difficulty may generally be traced to irregularity in charging.

As a general thing, castings high in silicon will be free from burnt sand. The test bars sent you contained over 3 per cent of silicon. The iron that you refer to must have been used as a softener and must have contained considerable silicon. There is, however, a difference in irons irrespective of the silicon which can be found by trial. The peeling of sand from a casting seems to be due to graphite which exudes from the surface of the casting before the sand has time to become attached to it.

Your shrinkage does not indicate more than about 2.25 silicon. An increase of silicon would decrease shrinkage and would probably increase the strength of castings less than half-inch thick; but if such iron is poured into castings one-inch thick the grain might be coarse and the castings consequently weak.

Four hundred pounds shows very good strength, and a shrinkage of .156 shows strong castings one-inch thick.

You should determine the hight of the bed by measure. Fill the cupola eighteen inches above the top of the tuyers with coke, then take it out and weigh it. Try one of coke to ten of iron for the other charges. You may be able to make the last two or three charges 16 to 1.

If you are not doing as well as this, begin by taking 25 pounds off at only one place and proceed slowly with any change.

Explosion of a Brass Pump Plunger.

THE FOUNDRY has repeatedly printed items concerning the explosions that have been caused by the attempts to melt castings that had been cast hollow and afterwards plugged up, such as pistons, shells, etc., and the following account of an accident that recently occurred at the South Brooklyn Steam Engine Works, South Brooklyn, N. Y., and for which we are indebted to the American Machinist, will prove interesting.

The South Brooklyn establishment has a large iron foundry, and a brass foundry which can turn out ten tons of brass castings daily. The pump plunger which exploded was blown into fragments with a loud report; fig. 1 is a reproduction of a photograph of one of the largest pieces found. It was, however, one of a pair of discarded marine pump plungers, and fig. 2 is from a photograph of the duplicate. The material is a yellow brass. The size of the plunger was about 24 inches long by 6 or 7 inches diameter, with a threaded stem on one end, the body being cored and plugged; the least

thickness of the fragment shown in the engraving is about ⅜ inch.

This scrap plunger was too large to go into the melting pots, and Smith and Higgins, the victims, intending to break it up with sledges, placed it in the furnace shown in fig. 3, and heated it, as they judged, hot

FIG. 1—A PIECE OF THE BROKEN PLUNGER.

enough to make it break easily, and then drew it out of the fire with tongs and laid it on the foundry floor near where the wheelbarrow stands in fig. 3. What followed is told by one of the molders as follows:

FIG. 2—THE REMAINING PLUNGER.

"When they took the plunger out I noticed it was hissing, and I said to one of the boys: 'There's a hole there, and those fellows may have an accident.' Then I passed by the men and spoke to them. They had the plunger on the ground, and one of them was hitting it with a sledge hammer. He hit it one blow, and as it hissed I said to him: 'Don't fool with that; bore a hole in it.' 'Oh, I guess it's all right,' he said, and he struck it again with the sledge and it blew up. I was standing ten feet away, behind a pile of iron castings. A piece of the plunger struck the castings and broke some of them. The place was all in darkness after the explosion, on account of the dust that was raised. I found my way out, and then we sent the ambulance calls."

When the dust and steam cleared away two men were found lying unconscious on the floor. In the case of one his right leg was nearly cut off and his left leg was broken in two places. In the case of the other both legs were mangled to such an extent that they had to be amputated.

Mr. J. H. Taylor, manager of the works, is reported as saying: "The men had been warned not to use their hammers until the plunger had cooled off. The foreman of the foundry told the helpers to bore a hole in the plunger. The men were thoroughly experienced; but in spite of the oft-recorded accidents caused by heating old pistons and plungers, they seem to have thought they stood in no danger, or else chose to take the chances, and did so with the deplorable results which followed."

The engravings are given, not to foster a morbid taste for the horrible, but to accentuate the lesson which the story of this explosion teaches. It is wrong for workmen and their superiors to permit the heating of any pieces of old machinery supposed to contain a closed cavity, without first boring a small hole in the piece. Cases have been known where violent explosions have followed the heating of hollow pieces which had no known means of filling with water, and it seems quite probable that oil was the material which caused the disaster. In any case, no matter what the size, shape or history of a piece which is hollow and has the hollow closed up tight, it must not be heated for any purpose, nor to any degree, without first boring a hole into the cavity; otherwise there is always risk of loss of life or limb and destruction of property. Steam pistons and pump plungers are especially dangerous parts of old machinery to put in the fire before venting.

FIG. 3—THE SCENE OF THE EXPLOSION.

Certainly, no reader of this story of the lamentable occurrence at the South Brooklyn Steam Engine Works who has a single grain of common sense, or is at all fit to have charge of workmen, will ever permit the heating of a hollow unvented piece of old machinery by men under his control. Let this lesson be fully understood, and constantly remembered: Any piece of old machinery, no matter what, so long as it has a closed cavity in it, can be heated only at the risk of accident. It may look silly to insist on drilling a small hole in every hollow piece, not already fully open to the atmosphere, before heating it; in ninety-nine cases out of a hundred the precaution may be needless, and the hundredth case may be that of the South Brooklyn pump plunger, and cause a horrible accident. The wise man is overcautious rather than foolhardy; and had Smith and Higgins relied less on past escapes from harm, and more on the not too apprehensive caution of their fellow-workmen, they would not now be in their frightful condition.

If a piece is hollow, bore a hole in it before heating it or putting it into a foundry cupola. Make this the fixed rule of your work and your establishment, and allow no deviation from it under any circumstances whatever.

Gun Metal and Bronzes.

The following, from a "Practical Marine Engineer," appearing in a late issue of the Mechanical World, will no doubt interest foundrymen and others besides.

Gun metal, or ordinary bronze, is an alloy of copper and tin with a slight percentage of zinc added to facilitate casting. The amount of tin varies from 8 per cent, in soft gun metal to 20 per cent in the hard varieties, and the zinc should not exceed 5 per cent, being generally less.

This mixture forms excellent castings, sound and reliable, especially when rapidly cooled, which may be done by using iron molds. It is very largely used in naval work for valves, valve boxes, bends, propellers, stern tubes and underwater castings generally; and occasionally for the shells and doors of condensers. The alloy is also most suitable for the bushes of journals, the harder qualities being adopted for this purpose. For underwater fittings (except propellers) about 6 per cent of tin is sufficient, but castings subject to high steam pressures should have from 10 to 12 per cent; and for bushes having no white metal wearing surface from 15 to 20 per cent of tin is used.

Gun metal does not roll or forge, and is not suitable for rods or fastenings which are liable to tension. Being much stronger than cast iron, and more reliably cast, its adoption instead of the latter saves a considerable amount of weight, but it is too expensive for us in the merchant service, where cast iron will serve. Steel castings are now being adopted in place of gun metal where great strength and stiffness combined with lightness are required, such as for the large fittings of the main steampipes of high-powered naval work. This alloy is more easily cast into thin castings of good size than brass because the molten metal flows better, and it is therefore more suitable for condensers, but also more expensive. The contraction in cooling is about ⅛ in. in 10 in. Gun metal is seriously impaired in strength by heat, the tensile strength at 500 degrees F. being less than two-thirds that at atmospheric temperature, which ranges from 14 to 17 tons per square inch, the strongest quality being that containing from 8 to 10 per cent of tin. The elastic limit is low, ranging from three to five tons in tension. The weight of a cubic inch is 0.31 of a pound.

Phosphor Bronze.—The addition of a very slight quantity of phosphorus to the other constituents of bronze produces great changes in the qualities, materially increasing the strength and ductility. A good alloy is produced by the combination of from 0.2 to 0.3 per cent of phosphorus with a mixture of copper and tin in the proportion of 9 to 1, but the amount of phosphorus varies in different qualities from 0.03 to 0.8 per cent. In manufacturing, phosphor tin, containing a definite known amount of phosphorus, is added to copper—a process which gives a fairly good control over the composition of the resulting alloy even when the final percentage of phosphorus is very minute.

Phosphor bronze can be rolled into sheets and forged into bars, and forgings of this material are very suitable for rods and fastening not subject to heat where strength and non-corrosive qualities are required. In sheet form the alloy is sometimes used for air-pump valves. It is largely adopted in naval work for rams and stern frames, also for propellers. Phosphor bronze is suitable for bearings, pump-water cylinders, and for piston rings, especially when working in steel barrels. It is not suitable for castings subject to heat, being liable to crack when hot, and the strength is reduced when heated even to a greater extent than with the other copper alloys. The tensile strength of cast phosphor bronze is from 17 to 22 tons per square inch, and that of forgings from 25 to 30 tons, the elastic limit being about 45 per cent of the ultimate strength. Being hard and tough, this alloy resists compression well, and will stand a great change of form without cracking.

Manganese bronze differs from ordinary bronze in having a slight proportion of ferromanganese in its composition, which greatly increases the strength and toughness. The amount of manganese varies from an almost imperceptible trace to as much as 5 per cent. There are five grades of this alloy made in this country (England), all of which can be cast in sand except No. 1, for which chill molds are necessary. The best and strongest forgings are of No. 1 grade, No. 2 being adopted for important castings, such as propeller blades. Nos. 4 and 5 are used for journals, being the most suitable for anti-friction purposes. The shrinkage is rather greater than that of gun metal.

Forged manganese bronze is suitable where great strength combined with non-corrosive qualities are necessary, such as for high pressure steam valve spindles, stays, thrust rods, etc. Although weakened by heat because the initial strength is too high, this alloy, when forged, is more suitable for use under heat conditions than any of the other copper alloys, with the possible exception of aluminum bronze. It was in great favor a few years since for the propeller blades of high-speed vessels, because of the good surface, fine edges, and thinness obtained, another benefit claimed being that the points were only bent and not broken when struck, and could be hammered into shape again. But the latter quality is a doubtful advantage, and a long experience has shown the necessity of making blades of this material as thick as those of cast steel, so as to provide sufficient stiffness; also the smooth surface gets gradually pitted when running, but not to such an extent as with cast-steel blades. As these considerations lessen the superiority of this material over others for blades, engineers are not now so inclined to incur the additional expense involved in its use.

The tensile strength of No. 2 quality, when cast in sand, is from 28 to 32 tons per square inch, with an elongation of 13 to 20 per cent in 5 inch, the elastic limit being from 15 to 18 tons. Rolled No. 1 quality has a tensile strength of 33 tons and an elastic limit of 22 tons, with an elongation of 25 per cent as delivered from the rolls. After cold-rolling, the ultimate strength is 40 tons, and the elastic limit 30 tons, with an elongation of 10 per cent.

Aluminum bronze contains from 7 to 10 per cent of aluminum, alloyed with copper; also traces of iron, silicon, phosphorus and other impurities, which, however, should be got rid of as far as practicable. These proportions of copper and aluminum have been found to give the best results as to strength, small cast bars having shown an ultimate tensile strength of 44 tons per square inch, with an elastic limit of 31 tons and an elongation of 10 per cent; still better results being obtained with rolled bars. This alloy shrinks more and cools more rapidly than gun metal, being therefore more difficult to cast. It is the least corrodible of the copper alloys, and it is said to have the valuable quality of withstanding a high temperature without loss of strength. Being also somewhat lighter than the other bronzes, it promises to become the most important of the group, but at present practical experience of its use is very limited. The presence of a slight percentage of aluminum in any copper alloy improves its ability to resist corrosion, and the water pipes of some marine machinery are now being made of a mixture of copper and aluminum in the proportion of 99 to 1; and it seems probable that aluminum-bronze forgings will soon supersede forgings made of the other special bronzes.

White Metals.—There are various anti-friction metals of this class, Parson's and Babbitt's being good examples—the latter an alloy of 10 parts of tin, 1 of copper, and 1 of antimony. When the surfaces work in water, Fenton's metal is very suitable, the composition being 8 parts of zinc, 1.66 of tin and 0.34 of copper.

Another good white metal with ordinary lubrication has a composition of 85 per cent tin, 9 per cent antimony, and 6 per cent copper. In some other successful anti-friction alloys, lead is the chief constituent. Before pouring white metal into place, it is a good plan to tin the surface which contains it, which in any case must be quite clean and dry. White metal is used for the bearing surface in some types of piston-rod packing, and in such cases care must be taken that the alloy has a fairly high melting point—say, not less than 700 degrees F.

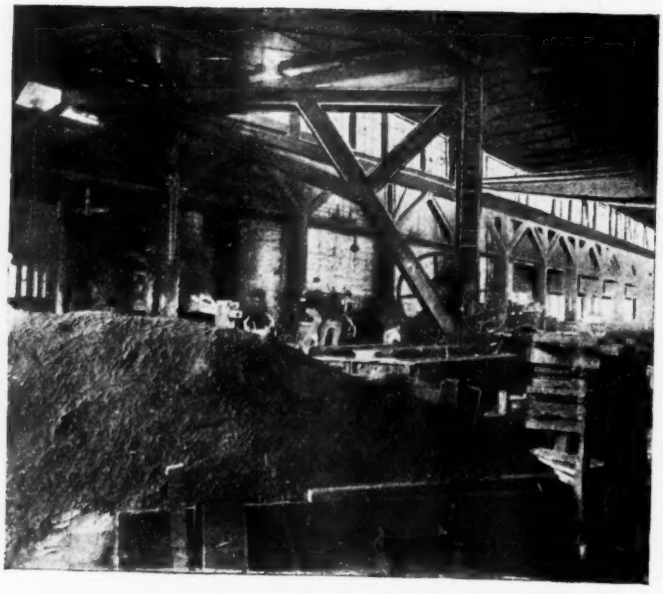
A Modern Foundry Plant.

Foundries are too apt to be neglected when the plant is being improved, but this was not the case with the Henry R. Worthington Hydraulic Works. This was established in Brooklyn in 1845, but owing to the limited space available it became necessary to use the ground occupied by the foundry for an addition to the machine shop, and the foundry was moved to Elizabethport four years ago.

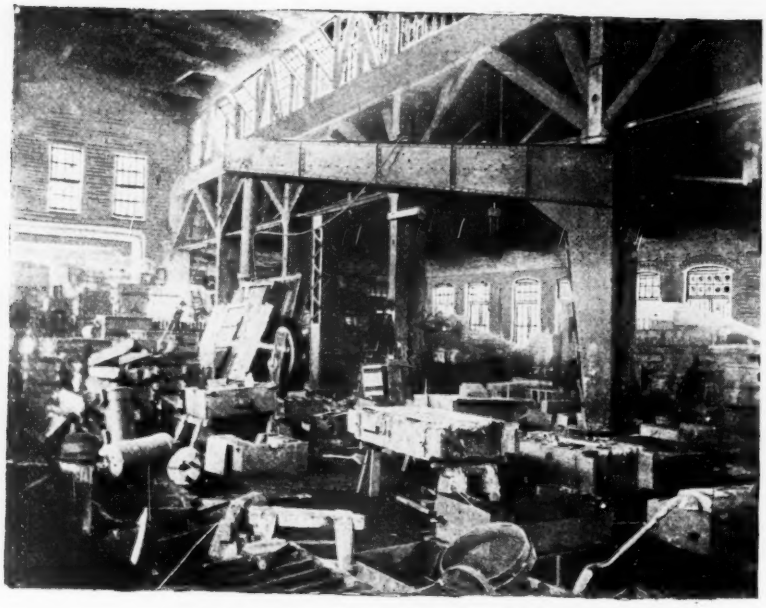
The new foundry plant occupies over ten acres and has ample dock and railroad facilities, their own steam lighter plying between the foundry and the Brooklyn plant. The foundry was erected under the supervision of their own engineer, and is very complete and modern in every way, turning out an

MAIN FOUNDRY—SHOWING CRANES AND SAND CAR.

A HEAVY MOLDING MACHINE WITH HOIST.



CUPOLA AND HEAVY CRANE.



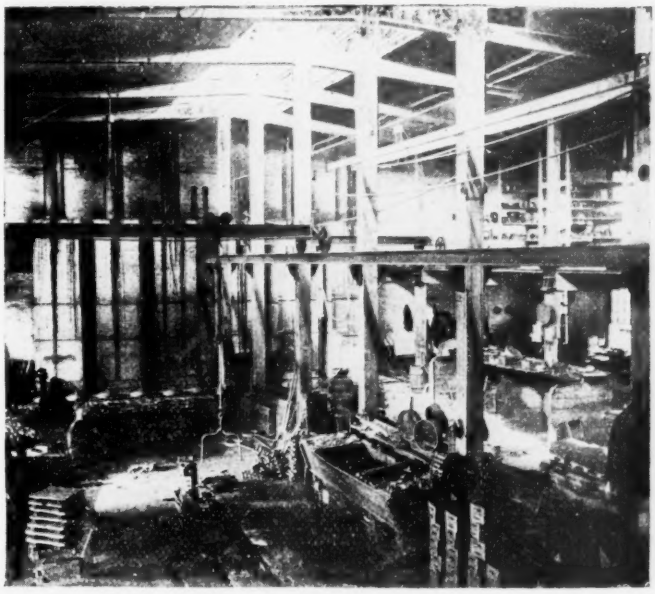
A CORNER IN FOUNDRY—HEAVY WORK.

average of sixty tons of iron castings and three tons of brass castings per day.

The buildings comprise the green sand foundry, 340 feet long by 120 feet wide; the loam foundry, 240 feet long by 90 feet wide; the brass foundry, 110 feet long by 80 feet wide; core shop, 100 feet square; pattern shop, a two-story building 80 by 80 feet with pattern shop storage building 300 by 80 feet, including a number of smaller pattern storage buildings for special patterns. There is also a storehouse for finished castings, 200 feet long by 43 feet wide, together with engine and boiler house, chipping shops, storehouses for sand and coke, etc.

close-grained and very high tensile strength particularly suitable for hydraulic machinery.

The main feature of the foundry is its molding machines, fifteen in all, of different sizes, varying from 32x32 inches down to 16x16 inches. The majority of these are pneumatic, the others being Tabor, and of their own make. Some of these machines can turn out over 250 flasks per day, the work being of a very superior quality. Each machine has its own pneumatic crane, and the speed with which it handles flasks and takes care of the molten iron must be seen to be appreciated.



BRASS FOUNDRY—AIR HOIST AND TRAVELING CRANE.

These buildings are all connected with a system of standard and narrow gauge tracks, to facilitate the quick handling of material. The buildings are equipped with electric power and pneumatic cranes, to an extent that is unusual in even the best equipped foundries.

There is one 30-ton, five 15-ton, three 8-ton, two 5-ton, six 3-ton, and fifteen cranes of 2 tons capacity and under.

In the iron foundries there are three cupolas, with an aggregate melting capacity of 30 tons per hour. Test bars from each heat are carefully tested, many of the castings being made of semi-steel, which possess a

The molding machines with their pneumatic cranes represent about 7 per cent of the cost of the patterns, and it is likely that this shop has gone further and been more successful in the matter of making large and difficult castings upon their machines than any other in the world.

As proof of this it need only be mentioned that here the majority of the steam and water cylinders of their smaller sized pumps up to those sixteen inches in diameter are all molded on the machine and with the aid of the pneumatic cranes with which each floor is equipped, the molders are enabled to put up an unusually large day's work.

All the flasks for the standard size are iron designed especially and the arrangements for fastening cores and clamping flasks are very ingenious and give evidence of much thought.

The brass foundry contains twelve furnaces, and has two pneumatic traveling cranes to lift crucibles from furnace and pour the molten brass in molds throughout the length of the shop. All standard work is done on the molding machines similar to the others described.

The castings are conveyed from the foundry dock by the company's steam lighter, which has a capacity for lifting a twenty-five ton piece, and carrying 250 tons. A special lighter transports heavier work to the works in Brooklyn, which will be described in a later issue.—Machinery.

Fire Fiend.

The Chicago architectural iron works burned September 30. Loss $15,000.

The Acushnet iron foundry at New Bedford, Mass., suffered from an $800 fire recently.

L. B. Coleman had a fire at his foundry in Elmira, N. Y., that was extinguished before much damage was done.

The large plant of the Chattanooga Stove Co., at Chattanooga, Tenn., was totally destroyed by fire September 28. Loss $200,000; insurance $40,000.

Deaths.

Col. John S. Elliot, of Bath, Me., died at his home there October 4. He was a member of the firm of G. M. Patten & Co.

Mr. John L. Thomas, superintendent of the O. G. Thomas stove foundry at Taunton, Mass., died very suddenly at his home October 7.

Harley E. Jones, of the firm of E. D. G. Jones & Sons, iron founders at Pittsfield, Mass., met a sad death by drowning while fishing in Pontoosur lake, in that state, September 24. One strange and unusually sad feature of this accident was the fact that it occurred on the gentleman's birthday.

Clarkson E. Toms, general manager of the Standard Radiator Co., St. Louis, Mo., met a horrible death from accident a few weeks ago. He was handling a pistol that he was examining because of a burglar scare in the neighborhood when it was accidentally discharged, the ball entering his mouth and passing through his head.

Notice.

Advertisements entitled Situations Wanted or Situations Vacant will be inserted in this column One Insertion FREE. All others, 25 cents per line.

WOULD LIKE to correspond with engine builder desiring service to foundry foreman. Twenty years' experience in all branches of the business; good references. Write for particulars. Address box 32, care THE FOUNDRY.

FOUNDRY foreman of large experience and with best of references is open for an engagement. Thoroughly understands mixing of metals, managing men and the economical production of work in accordance with modern methods. Address box 34, care FOUNDRY.

WANTED—A position as foundry foreman or superintendent by one who has had charge of one of the best-known shops in America, doing the heaviest and most particular class of work. Address box 33, care THE FOUNDRY.

FOR SALE—No. 3 Root blower, used only few months; to be replaced with largest size. Address box 4, care THE FOUNDRY PUBLISHING CO.

FOREMAN molder for radiator shop; must thoroughly understand his business. Address Holland Radiator Co., Bremen, Ind.

WANTED—A position as brass foundry foreman; have had twelve years' experience as foreman and can give the best of references as to ability. Address box 14, care THE FOUNDRY.

FOR SALE—One 6,000 capacity screw ladle, made by Obermayer & Co.; been used about two dozen times and kept out of the weather. Address S. A. DENYER, box 158, Thibodeaux, La.

The J. A. Fay & Co., Cincinnati, O., have issued a supplementary catalogue containing illustrations and descriptive matter of their variety and universal wood-working machinery. As these machines are of especial value to patternmakers because of the many uses to which they can be put, every pattern shop should have one.

Some Foundry Kinks.

By H. HANSEN.

When we meet a job that we cannot butt off, roll over and draw the pattern and make a good casting there results a "kink." The foundry is full of them. Everyone who has ever shoveled a sand heap over can tell you his little story of the casting that refused to materialize until compelled to by a kink. It will always appeal to the observing, who feel that there is more than one way of doing anything, and of the good results attained by leaving an imprint of "kinks" on one's mind for future reference no one can doubt who is compelled to change from one thing to another. What we need, however, is an exchange of "kinks," for if we only know those we fall over in the shops; we never get acquainted with but few. Prejudice against other ways of working should not exert a dominating influence over us in such matters, where, if we don't accomplish any good, we can at least do no harm.

Small, delicate bodies of sand have always been the torment of the green sand molder.

FIG. 1.

In large bodies there is room for securing, while with small ones the molder must work according to the dictates of his conscience. After all it is always small things that cause trouble; even in large work when defects show up they are generally produced by some cause so insignificant that it has been entirely ignored. Look out for the small things on any job; that is the "kink" to success in molding. Large things will show their symptoms plainly should anything be wrong. The longer we live the greater becomes the number of these tender spots that we are called upon to keep in place. Modern designing pares off every superfluous pound of metal and gives us a place to use a few "kinks."

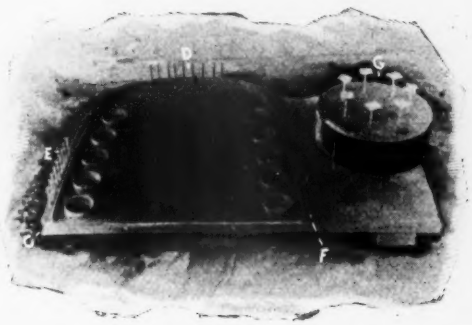


FIG. 2.

We will begin with something familiar—a small web pulley, Fig. 1. Between the hub and rim there is but a small space, yet secured it must be in cope and nowel both. At A is shown some of the familiar "Dutchmen." They look rather clumsy and crooked, but they appear natural at least. How a molder manages to ram even around these is one of the peculiarities of the trade. As long as these soldiers keep the sand from dropping off, they are, as far as the cope is concerned, performing their mission, but in the nowel securing is done for a different purpose than to prevent a drop-out. If we gate this pulley on the hub, there is a tendency to force the green sand center outwards, and in securing with rods and soldiers there is the chance of the part lying between each of them giving away. If we gate it on the outside, there we are again, the outside filling first producing a compressive force on the core, though this is to be preferred since the core, being cylindrical in form, will stand a greater compressive than expansive force. If we could fill this mold up evenly, the nowel would cease to annoy us, and we would not get a chance to observe a lesson in hydrodynamics.

At B is the "kink" in the case. It is nothing but a common piece of stove-pipe cut off at a suitable length. Compare it with its right-hand neighbor, and say which you think is the most progressive, which you believe offers the best chances for obtaining a good casting. You can gate your pulley where you please, and there is no danger of

bursting the core; no wood to swell up and raise a fuss when the iron reaches it; no large wet spot to scab off as there is with the soldier. It is neat, clean, convenient, cheap and secure; it is a "kink."

At C, Fig. 2, another small nuisance is shown, consisting of the narrow pocket surrounding the outer edge of the casting. If you should get such a job and realize that the chances were in favor of said pocket "washing," what would you do? Oh, yes; rush upstairs and gather a handful of spikes and set them in. Head down, as at D? No; you know better; point down, as at E. Correct. But what would you do the next morning when you found some of the spikes sticking fast to the casting? Keep out of the old man's way, and use more spikes next time. Wrong. Use the "kink" at F; some pieces of thin sheet iron. You can bend them to any circle, and when you use them you can look the old man in the face without expecting an eye opener.

G is a piston head. Some of these are lost (through the coremaker's fault). Did you ever hear the chipper swear at the rods that were inside and refused to come out? Everything about such a job must be of exact dimensions—core right thickness, chaplets right length, etc. In this piston head are shown seven small chaplets, which are placed in position in the pattern before ramming up, and when the pattern is withdrawn are left in the mold. They extend into the pattern the exact distance of the thickness of metal required, and being provided with heads about an inch square do, with a cope of reasonable depth, furnish sufficient protection against the core raising without being wedged down. The reason so many are used is to avoid employing rods in making the core. It is a time-saving "kink," the exactness of which can only be appreciated by a trial.

Some molders seem to think that they must have a trowel or a slick in their hand and a couple of big lifters dangling out of their hip pockets before they are true representatives of their calling. Now, while it is true that they, as well as others, need proper tools, still it must also be conceded that these should only be used in their proper place. There is something unmechanical about a molder when we see him scraping the surplus sand off his box with a trowel, when he could do a better job a great deal easier with a shovel or a piece of a board. There is something simply outrageous in the actions of a molder making a joint or filling a soft spot with a tool when he has two hands, the best tools ever furnished any molder. We smile at the "hobo" whose only tool is a big spike; yet between him and those who are continually flourishing their instruments and who can't shove a nail down without they do it with a tool, the "hobo" has less scabbing and blowing because he doesn't spoil his molds with slicks and slicking.

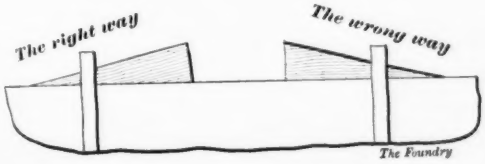
On par with the injudicious use of tools is the reckless handling of the vent wire. We see a molder stabbing away for dear life and gossiping with his neighbor at the same time. No wonder the iron comes popping up through the cope at casting time. Better

FIG. 3.

not have wasted muscle and time. As an old Scotchman told us, one judicious vent is worth a dozen administered with a careless hand. To vent delicate cores in a useful way takes time, though the operation can be greatly facilitated and the vents inserted perpendicularly by the aid of a square block, as shown in Fig. 3. Tools never made a mechanic of any one, and when and where one uses them will to a certain degree indicate the extent of his apprenticeship.

Do you believe that there is a right and a wrong way to drive a wedge? There is. There is a "kink" in doing most anything. Referring to Fig. 4, where is illustrated the right and wrong way of driving a wedge, we wish to state the reasons for our assertion that there are two ways of doing even such

a simple job as driving a wedge, and what is referred to here is the old standby—the wooden wedge. Glancing at that part of the sketch marked "the wrong way," it will be observed that the grain of the wood lays in such a direction as to offer an ideal chance for breaking the wedge. Compare it with the wedge marked "the right way," a little reasoning will in itself offer a better explanation than a whole column of reading matter could do. A wooden wedge when made right is a right-angled triangle, two of them forming a rectangle. In driving a wedge the hypothenuse or longer side should always be the lower side. It will add to the life of the wedge and give a better result in



How to drive a wedge

FIG. 4.

clamping than where they are shoved in haphazard and split open, not so much because they are poor wedges as because an unreasonable demand is made upon them by workmen whose knowledge, as far as wedges are concerned, is below the quality of the wedges.

"Kinks" are the order of the day. It is only another name for inventiveness. Those who want to escape irksome drudgery plan and consider, reason and think and produce the time-saving, money-making "kink."

Compressed Air as a Hoisting Power in the Foundry.*

BY G. A. TRUE.

So much has been said and written upon the general uses of compressed air as a distributing power, that it will be unnecessary to consider it in its broadest sense, but more can probably be gained by treating of its special applications to certain fixed duties. Undoubtedly its greatest services are of the future, and we are probably but on the threshold of its greatest development. It is to be hoped that it will not be overrated by the amount of praise that has been bestowed upon it during the past few months. Paper has followed paper, and trade magazines and periodicals have vied with each other in their efforts to obtain new data regarding this interesting but not newly discovered power. The machine shop, boiler shop, the mine, the quarry are all largely using it. The street railways are investigating it with a promise of giving it at least a fair trial, and there are almost unlimited opportunities open for it in the domestic and light manufacturing field, only awaiting a public supply of both compressed air and of a more general knowledge of its advantages as a safe, elastic and convenient power. It is of its service in the foundry, and especially as a hoisting power, that this paper will treat. But before taking up the immediate subject at hand, it will be necessary to consider for a moment the adoption of air as a principal distributing power for all classes of foundry work. So wide are its applications in this line that one is tempted to see a foundry with no steam engine other than the one which drives the piston of the air cylinder of a compressor—unless, under favorable conditions, a separate steam engine be used for the blower. If the writer were to-day installing a foundry of, say, 20 to 50 tons daily capacity, the temptation would be strong to adopt compressed air as the only transmission power. We are not aware that such an example exists in foundry practice, and can recall but one instance where this system has been adopted as the prime distributing power by a manufacturer in any line, and that one, the Weurpel Co., of St. Louis, was unfortunately short lived, and afforded but little opportunity to show what could really be done.

The power problem of the foundry, however, seems to invite a ready solution by this system. The various power units are almost invariably widely scattered, and many times must be portable, necessitating a power easily distributed over a large area. In the average foundry the fan or blower is the principal item of power consumption for several hours during the day; and the power system, if tabulated, would result somewhat like the following, taking as an example a foundry of 30 tons daily output:

*Paper read before the September meeting of the Western Foundrymen's Association.

Blower.....	20 h. p. for	4 hrs.	=80 h. p. h.
Mills and misc. power.....	6 h. p. "	3 "	=18 h. p. h.
Hoisting..... Average	5 h. p. "	10 "	=50 h. p. h.

The last power item is intermittent in actual work, but the need of it extends throughout the day and calls at times for a much higher horse power than the above average, but generally a much lower amount of power is used. If the foundry is modern and progressive it will also use power for sand sifters, air chippers, cleaners, etc., and under special conditions other power machines would be desirable if air is used, when they might be impracticable under any other power system.

The predominant practice of the present time is the installation of one steam engine of sufficient power to meet the demands of the entire establishment, and the distribution is effected by means of line shafting and belts. In occasional instances electric motors are economically used for the distribution of the power. Frequently a separate steam engine runs the blower, while a system of shafting and belts attends to the balance of the equipment; but it so happens that the arrangement of an average foundry is such that power so applied is invariably on a most wasteful basis. Countershafts, clutches, bevel gears and combinations of square shafts and worm gears (on cranes especially), all running for the entire ten hours, results in a tremendous waste of power; 50 to 60 per cent of the power is often used in turning the shafting alone, not to mention the loss resulting from the peculiar style of mechanism made necessary by the use of line shafts, and this friction loss goes on steadily throughout the day. This one item has furnished the electricians with one of their best arguments for the adoption of an electric motor system for driving the various tools and machines used intermittently, and the same claims can be advanced with added emphasis for compressed air. The writer recalls one instance of a foundry (or rather a group of foundries, melting over 100 tons daily) in which over 400 feet of shafting conveyed the power to the various widely separated machines, and 500 feet would probably be a low estimate of the amount of belting in daily service (and this does not include a rope drive or two), all in constant motion whether doing useful work or not.

With a compressed air system, using engines on each machine, power is used only while the machine is in operation. When it stops the consumption of air stops, and the air in the service pipe will stand idle all day if necessary; then when required it is instantly ready for service if even for a moment only. We all know how tempting the use of separate steam engines has been in the past, and that the principal objection to that system is loss through condensation. Their use on cranes has been curtailed owing to difficulties attending transmission of both live steam and exhaust. It is in this intermittent work that the largest item of saving records itself, and much of the power work of a foundry is intermittent. Especially does this apply to the various hoisting operations.

As stated above, the average amount of power utilized in hoisting will probably be about five h. p. for ten hours. This appears a low estimate, and it will seem lower when we consider the amount of hoisting done as expressed in ton feet, but in reality it is a very liberal estimate if we take the power actually utilized. But in a belt power establishment it is more because so much power is consumed in turning the shafting and because power thus used goes on continually and not intermittently, as in a motor or engine system.

Let us consider in a general way what amount of hoisting is actually done in a machinery foundry of, say, 30 tons daily capacity. It will probably seem greater when represented in dollars and cents. We will assume that the iron and coke is unloaded by the wheel-barrow method, and will not consider that, nor indeed any work which does not require the service of either a hoist or a crane. Let us begin with the elevator. Modern practice places the charging floor from 16 to 22 feet above the ground. The entire 30 tons of iron must be hoisted this distance, so we have the daily hoisting represented, 30 tons x 18 feet = 540 ton-feet iron and about 4 tons x 18 feet = 72 ton-feet coke. The lifting of flasks, copes, etc., is more difficult to estimate, but as nearly as can be obtained by actual observation it will amount to an average daily lift of 500 ton-feet. Of the 30 molten tons of iron, 20 to 25 tons will be many times handled by cranes, and the various operations of shaking out, storing

flasks, cleaning, chipping, loading and breaking castings represents 900 feet-tons more. This, in all, equals about 600 feet-tons for the elevator service and about 1,400 feet-tons for general crane service, making a total of 2,000 feet-tons per day, or an equivalent of 2,000 tons hoisted one foot or one ton hoisted 2,000 feet. Of course this result would vary greatly with different kinds of work. A pipe foundry would show a much higher result and a foundry making light castings would show a smaller total, but we will take as our example a foundry whose hoisting represents 2,000 ton-feet daily, and this generally will be a 30-ton plant.

What is the best power with which to handle this material? The correct answer is that probably no one power is best adapted for all the various operations; but, assuming that one power is to be used, it seems to the writer that compressed air is the most available.

Mr. Richards asserts that compressed air costs about five cents per 1,000 cubic feet of free air. This is the basis usually taken in making estimates, and at first thought it seems to be very cheap, but with a modern four-stage compressor the cost will be much less; in fact, in some cases it is difficult to see how the cost per 1,000 cubic feet of free air can reach four cents, including depreciation, repairs, oil, fuel, interest and miscellaneous items. Assuming five cents, however, as a basis, the power cost of lifting one ton one foot, in a direct acting air hoist, is about .0007 of one cent, or to put it on a more comprehensive basis, seven cents per 1,000 ton-feet. We have already seen that the average amount of hoisting in a foundry of 30 tons daily output was 2,000 ton-feet, so the power cost of doing this work, including power repairs, power labor, fuel, oil, interest, etc., is not over 14 cents per day. The operating labor is to be added to this to estimate the total cost of hoisting. (In these calculations the hoisting is alone considered, and we may assume that lowering is done as cheaply by one power as another.) In order to obtain the operating labor cost we must first obtain the speed of hoisting. We have made a series of tests with hoists ranging in diameter from 4 inches to 16 inches, and in capacity 600 pounds to 6 tons. On small hoists the valve ports were approximately of inch 1-10 area, on larger hoists some were of this area, others of 1-5 inch area. The speed of hoisting varied from 25 feet per minute in six-inch hoists, fully loaded, to six feet per minute for six-ton hoists. The average speed was found to be not far from 20 ton-feet per minute. Of course under high pressure this would be increased, but the object was to find a safe average speed for normal service.

Taking this on a basis of 2,000 ton-feet per day, assuming the operator's labor at $2 per day, we have an operating or attending labor of about 25 cents per 1,000 ton-feet. The total cost, therefore, of hoisting one ton 1,000 feet will be about 32 cents, or in a foundry of 30 tons daily capacity about 65 cents per day, using direct-acting vertical air hoists. If geared hoists are used, the amount of air necessary to lift a ton-foot will be increased and the power and operating cost will be more nearly represented by 90 cents per day.

Here we may call attention to the fact that the ordinary vertical direct acting air hoist is one of the most efficient hoisting machines in use. It utilizes in useful work fully 85 per cent of the power delivered to it. Few geared hoists, electric, hand, air motor or steam, have a higher efficiency than 60 per cent. Some electric cranes show a loss of 65 per cent in friction, or 35 per cent efficiency, although the average efficiency of the electric crane gearing is perhaps nearer 50 per cent. The average hand power crane with a drum winch shows only about 45 per cent efficiency, based on the power delivered to the machine. The average differential or worm-geared chain-hoist has 30 to 40 per cent efficiency and the cost of operating, measured in time and wages, is immense.

For the purpose of comparison, assume the foundry mentioned above to be equipped with hand-power cranes. The average speed of hoisting by hand-power, using one man, is about one ton hoisted two feet per minute. For short time work it is a little greater, but for steady work it is less, and on chain blocks or worm gearing it is not much more than one ton one foot per minute. At a "two-ton foot rate" it would cost by hand-power $2 50 per 1,000 ton-feet, against 45 cents per 1,000 ton-feet for air hoists doing the same work. Or, roughly, in a 30-ton per day foundry, $5 per day represents the labor of hoisting by hand-power against 65 cents to 90 cents per day by air hoists—a

saving well worth considering. It may be pointed out that this saving would be equally great when using other mechanical power than air, but this would be true only when applied under certain conditions, as for instance, handling uniformly heavy loads, and even then, as indicated, the power item would be 40 to 50 per cent greater, owing to the low efficiency of the geared machine as compared with a direct acting vertical hoist.

Another advantage of the direct acting air hoist is the wide variation of speed obtainable by the simplest possible means and involving practically no waste of power. With a fixed load the speed will vary automatically with the size of the port; and with a fixed port opening the speeds will vary with the weights lifted. The area of the port opening of the valve may be controlled in the usual manner by the distance the valve is opened, or in the best valves a throttle is provided independent of the main lever, and this being fixed for a given port opening, the valve may be thrown fully over. This device will be appreciated by any one who has attempted to control the port opening on a hanging hoist by pulling on cords attached to the lever.

Thus far comparisons have been made with the direct acting or "cylinder" hoist, which is essentially a cylinder of cast iron, or steel, or brass, accurately bored and polished inside, and fitted with a piston and piston rod, and to the latter is attached a hook, and on the cylinder a hook or ring is provided for attachment to the trolley or beam overhead; the cylinder thus hangs vertically and the load is lifted by the admission of compressed air on the under or "piston rod end" of the cylinder. This is apparently a simple machine, but if accurate or efficient work is desired great care and experience is necessary to properly construct it. Once properly made it is easy to take care of, its parts are few and not subjected to much wear, and are cheaply and easily replaced when worn. A poorly designed hoist or one cheaply constructed is not a good investment.

This cylinder type or direct acting hoist is capable of a number of modifications. The cylinder, with its heads and piston, its hooks and stuffing box, occupy considerable space vertically and require usually a fairly high ceiling. This should be borne in mind when selecting the hoist, for a very common mistake is that of choosing too long a stroke for the ceiling space. The distances to be added to the stroke to get the total length between bearing points of hooks when hook is lifted to its highest point (or to be added to double the stroke when hook is extended, to secure length over all) range from one foot in the small 4-inch or 5-inch hoists to two feet in the 16-inch to 20-inch hoists. If a swiveled hook is used these dimensions are increased about 50 per cent. Many times a long stroke is asked for when a short stroke would do as well; there is no advantage in this, and it is usually unsatisfactory because it really reduces head room rather than increases it. Probably the foundry of the future will have its very lowest ceiling not less than 20 to 25 feet high, because vertical air hoists will become so essential that their influence will assert itself upon the architecture of the plant. Horizontal cylinders may be used in exceptional cases where vertical hoists cannot be used, and these are constructed in a variety of forms. The cuts Nos. 4 and 5 shown in plate A illustrate one type, and they may be applied to cranes in numerous ways. No. 3 shows another method of securing a high lift in a small head space. Other special applications of air hoists are also illustrated. No. 1 shows a hoist supporting a long operating cylinder upon its piston, designed for grappling. Two cylinders may be also readily combined for tipping a ladle or dumping a bucket by somewhat modifying this design. No. 2 illustrates a vertical storage hoist designed by Mr. Fisher, of the Griffin Wheel Co., and used in its plant. The ordinary vertical hoist is surrounded by a small receiver, and when traveling a considerable distance and the load is to be lowered and another load raised, air is taken from the receiver for this purpose. This is applicable to locations where a hose cannot conveniently be carried. Wherever an air cylinder can be used, however, whether on cranes or elsewhere, it is desirable to use the vertical direct acting type, because it is more easy to operate, is higher in efficiency, and hoists with a more even and smooth lifting motion than do horizontal or other types.

The elasticity of air when used in a direct acting hoist is well known and is many times an advantage. In a well-made hoist properly

cared for, the lowering of the load due to leakage is not sufficient to cause trouble. A uniform load may be held usually for several minutes at any point without perceptible drop. If it is desired to hold the load for a longer time, this may be accomplished by raising the piston to the top of the stroke and leaving the air pressure on; or by adjusting a slipping or pinching collar on the piston rod the load may be held by air pressure at any point. The raising of the load when pouring metal, due to expansion of air in the cylinder, is generally an advantage, obviating the necessity of hoisting the ladle as it empties by opening the valve. If the rise is too great, a little air may be released. For certain special duties some hoists have been equipped with automatic release valves, others with slides and valves which automatically open for the admission of air to compensate for leakage and for the release of air when the load rises. An automatic means for closing the valve at top of stroke is serviceable in saving air and is assumed in the calculations in this paper.

When applied to cranes, positive action of the load may be obtained by the use of a water reservoir between the air pipe and the hoisting cylinder, with a regulating valve between reservoir and hoist. The hoisting cylinder then becomes practically a hydraulic hoist and should be constructed as such. The whole appliance is essentially a hydro-pneumatic hoist. The speed may be perfectly controlled by the regulating valve, or the load may be held indefinitely by closing this valve. An appliance of this kind is of course open to the same objections that are advanced against a hydraulic hoist, especially in an exposed location subject to a freezing temperature. This may be overcome, in a measure, by the use of oil or an anti-freezing mixture in the reservoir. The hoisting cylinder may be placed horizontally with the reservoir below it, but there is less friction and better results generally obtained from a vertical cylinder.

There are numerous places where a direct lifting hoist cylinder, either vertical or horizontal, cannot be used. Scant head room, short spans or jib of cranes, and occasionally a demand for a perfect or positive action without the elasticity of direct pressure, sometimes prevent the use of hoists of this character. It is here that the geared or air motor type finds its field of usefulness. We are all familiar with the modern three-motor electric crane and with the well-known steam jib crane so generally employed in pipe foundries. Undoubtedly the electric crane owes its popularity largely to the ease of transmitting the power from a fixed point to a moving machine. Until its appearance, the power traveling crane in general use was either belt or rope driven or operated by a square shaft. The power was subdivided and reversed by an intricate system of clutches, bevel gears and frictions. No one would now think of returning to that "all day" fuel consuming method unless the crane travel was exceedingly short, or the conditions much more favorable than usual. The electric crane offered emancipation from such systems, in the form of independent motors for each function, an easy method of reversing, and a consequent minimum of mechanism, outside of the motor, a variety of speeds and a simple and highly efficient method of transmission.

The three-motor compressed air traveler possesses all these good points, with the addition of lower first cost and greater simplicity. With a proper pipe-line the transmission loss is less than in electricity. The engines are as simple as those used for steam and may be easily reversed and controlled. Rheostats and expensive controllers are not needed; and the speed is reduced by throttling and saving the power rather than by consuming it. The valves may be controlled as easily from the floor of the shop as from a cab—a feature well worth consideration in a shop of limited output where a crane man's time in a cab is a serious item of expense. The half-tone cut on opposite page shows a 10-ton air motor crane operated from the floor. This crane was originally designed for operation by electric motors, but at the last moment air was substituted with equally good results. The air engines were applied in the same manner that electric motors are, and owing to their compact form the air crane trolley is much smaller than the electric trolley. A muffler is provided, making the crane operate with as little noise as when operated by electricity. The span in this case is so short that travel of the trolley is effected by a pendant hand chain, and a cab was not considered necessary. In certain

classes of foundry work a number of these cranes (one for each group of molders, for instance) running on a series of parallel tracks and operated by the men on the floor, would undoubtedly possess many advantages over a single traveler of long span attempting to cover the entire foundry floor. The speeds of travel and hoisting may be made as high as in an electric crane, the power of the engine employed being the only limit to the speed.

The air is usually carried in a rubber hose. The slack of the rope is supported by a number of small trolleys riding a taut horizontal wire along the crane runway. The hose connection is made at one end of the runway and as the crane travels out it simply pulls the hose after it, and when it returns the hose is pushed before it, folding back against itself as the trolleys are pushed together. We have carried air in this manner a distance of 250 feet without the slightest trouble. The beauty of this system compared with other hose systems is the absence of couplings and connections and the consequent small opportunity for leakage. Sometimes when the travel is long, several wires are used, each supporting a separate trolley. The connection between the main supply pipe and the hose may then be made at any point along the track, for the trolleys can pass each other. The hose in all cases should be amply large, three-quarters to one and one-half inches, depending upon distance, and three to four-ply of good quality.

Air engines may be applied to jib cranes, elevators and other hoisting machinery with equal ease. They may be applied to the travel gearing of a crane with relatively equal saving as when applied to the hoist. Compact reversible engines may be readily and cheaply applied to present hand-power cranes without materially changing the design, and the crane may still be operated by hand power at times when the power plant is not in operation. Air may replace steam in engines now in use on steam cranes. It is somewhat remarkable that founders making cast iron water pipe have not long ago adopted compressed air as a crane power. The conditions are peculiarly well suited for air; excessive heat, dust, smoke, intermittent work, and widely scattered machines in foundries of this class all offer it an inviting field. At present many of these foundries are operated by steam jib cranes, which could easily be converted into air driven machines. Some of the more recently built pipe foundry plants have installed electricity on traveling cranes, but if there is any place where air would be emphatically advantageous it is in these shops. With steam there is a great loss through pipe condensation, and the already heated air is rendered further uncomfortable by escaping steam and heated engines. Compressed air could be exhausted directly into the atmosphere of the shop and would assist in some degree in cooling and ventilating. There would be practically no loss in the pipes, as compared with steam. Air is a humane power. It does not hurt a man if he is struck by a jet. It doesn't make him upcomfortable. It is the most pleasant of all transmission powers to handle and the most convenient to subdivide.

The application of air motors also, to the gearing of existing hand-power cranes, would result in a large annual saving; it would in many cases pay for the investment in less than one year after installation.

In the consideration of compressed air for operating a hoisting plant, the question of efficiency will at once suggest itself. There is a much discussed loss of power in the compression of the air, the importance of which may be great or small, depending upon the conditions. These should always be considered, and the question of availability and economy should be looked at practically as well as theoretically. It will be well to remember that all systems embody power losses, some greater and some less than the power here under consideration, and many actual examples may be pointed out in which even electricity as a hoisting power is less efficient mechanically than air. And it is doubtful if one-half of the belt power or square shaft cranes in use will show as great economy in the use of power as a well designed air crane, without considering the large waste due to continuous motion of transmission parts, whether doing useful work or not. When the question of absolute saving in dollars and cents at the end of the year is considered, there appears in many cases a decided balance on the side of air. When using a direct acting hoist system, with a hoisting machine efficiency of 85 to 90 per cent, a higher net efficiency

for air than for electric or any other modern and practical shop power can be claimed with reasonable assurance. Using a mixed system, hoisting about half by means of geared hoists and half by direct cylinder, we may claim fully an equal efficiency with an electric geared hoist system. And using an air motor crane alone, as compared with electric

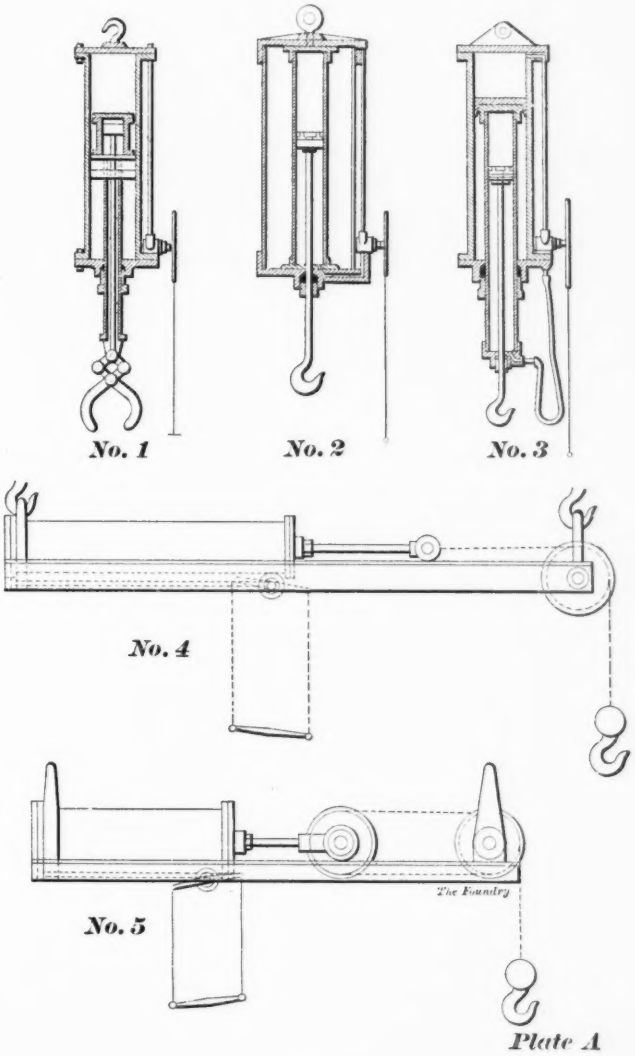
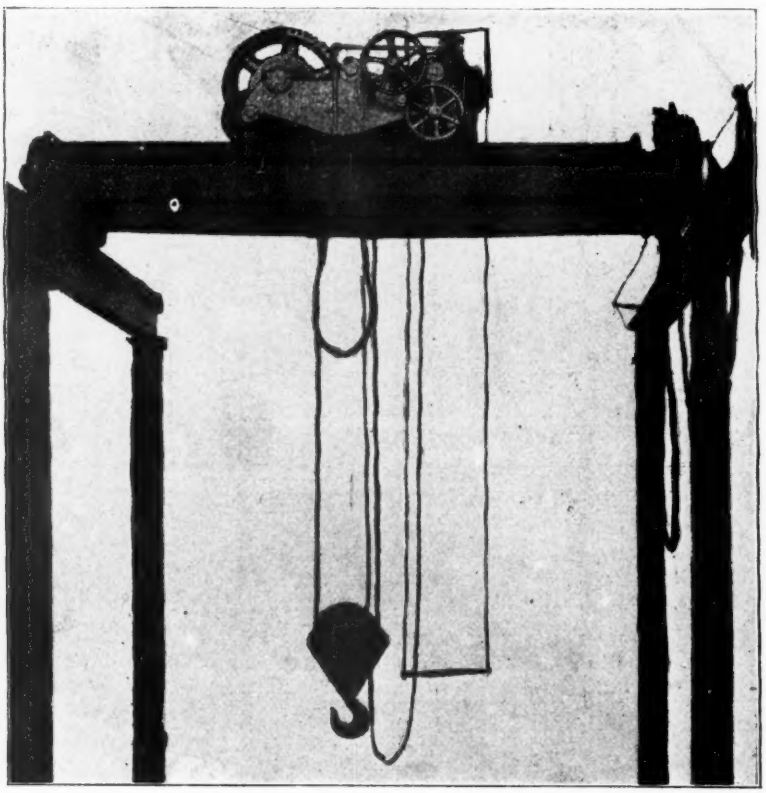


Plate A

motor, although probably a less power efficiency is obtained, a higher economy, investment considered, may in many cases be safely claimed.

If the power at the steam engine of the plant is taken at 100, and if we deduct, first: Percentages of loss for engine and dynamo (or engine and compressor), as generator loss; second, wiring, piping, or belting as transmission loss; third, the loss in motors or air engines, or clutches, as power transmitters to the gearing; and, finally, the friction loss of the hoisting gearing itself, we will find but a small percentage of the initial engine power has been expended in useful work. While the conditions vary greatly, we may make a reasonably accurate comparison on a maximum load basis which would show the percentage of power expended in useful work to be as follows: Using electricity as a trans-

mission power, with geared hoists, about 30 per cent; using air driving motors on geared drum hoists, 24 per cent; using a system composed of half geared hoists and half direct hoists, 35 to 40 per cent, and using all direct hoists, 50 per cent. Of course, when handling lighter loads the efficiency would be less. Such results surely do not make a bad showing for air. There is undoubtedly a fair saving power in favor of the electric motor crane alone, but this showing of increased



efficiency for electricity does not mean necessarily a greater annual economy; and a reduction to dollars and cents involves consideration of items like interest on investment, care taking and operating labor, every item of which shows a gain for air. Here is a difference between efficiency and economy. A machine may be highly efficient mechanically and still be comparatively uneconomical financially. An electric crane costs more than an air crane, and the interest on the difference in first cost will generally amount to more per annum than the saving in fuel due to the higher efficiency. It is our belief that the three-motor air crane, for instance, would not represent a greater expense per annum, investment considered, than a three-motor electric crane of the same size and capacity. Making a comparison with hand power, as already stated, the cost of hoisting by manual labor in the foundry under consideration would be not far from $5 per day, equivalent in good times to $1,500 per year. By air it would cost $200 to $250 per year, or, if we include interest on the investment, which is only fair, we will have a hoisting cost, when operated by hand power, of about $1,600, against $380 to $480 using air. The saving would go far toward purchasing a first-class air plant.

A further comparison with steam, hand,

belt or electric power would call into consideration various conditions under which sometimes one power and sometimes another might be the most available or expedient. It is not our intention to in any way decry the use of electricity or other power when conditions undoubtedly recommend the use of either. It is our aim, however, to call attention to a power which has hitherto been largely left out of consideration as a shop transmission power and which, in our belief, fully deserves consideration on its merits. It is undoubtedly more economical in many cases than either of the other powers mentioned, and in numerous instances more efficient mechanically; in nearly all cases it is the most convenient.

Consideration of compressed air, aside from its use as a hoisting power, is outside of the province of this paper, but since reference has been made to its exclusive employment in a plant, the subject of its availability for other purposes in foundry practice may be briefly noted. As already shown, the greater amount of power in the ordinary foundry is required to operate the cupola blower. In an imaginary foundry operated exclusively by compressed air, this blower, even if located at a distant point from the boiler, could be readily driven by a direct connected air engine provided with an inexpensive reheater, at an economy equal to, and many times greater than that obtained by a steam engine directly attached.

There are well-known advantages in operating a blower by an independent engine using either air or steam, the principal one being the ease with which change of blower speed may be effected.

In plants having the blower located close to the boilers, steam could be used advantageously in the engines and the air compressing plant be correspondingly reduced in capacity. The tumblers could be readily operated by motors, and here the exhaust could be also utilized. Sand sifters, portable or otherwise, are more readily operated by air than by any other power. A small hose, with a nozzle attached to overhead joists, serves as an unexcelled bellows for dusting molds. The air chipping tool and pneumatic sand blast promise improvement in the work of cleaning castings, and the castings may be readily broken by pneumatic drops. In many cases it has been found advantageous to weaken a heavy casting by drilling a line of holes in it with a portable air drill, after which it readily succumbs to the blows of the drop. The advantages of an air elevator are covered by our reference to general hoisting.

These are a few of the many diverse applications of air in a foundry which readily cluster around an air hoisting plant.

It may be advisable here to offer and repeat a few suggestions as to the proper care of such a plant, especially that portion of it relating to the hoisting appliances. The foundryman must not get the impression that all he has to do is to have the machinery installed, and that it will operate without further care or attention. Compressed air enjoys no special privileges. Its components are not exempt from those laws that govern other elements, and knowledge of this at the start will often save trouble later. For instance, air has an advantage over hydraulic power in exposed locations, because it will not freeze; but if the pipes are improperly installed, the heated air will deposit water which will collect in inviting places and freeze as readily as any other water. This may be avoided by properly draining the pipe line, or in particular locations, protecting it. Leakage is another item easily avoided if the plant is carefully installed. Large pipes should be used—one and one-half to two and one-half inch mains, the larger the better, with smaller connecting pipes. The receiver should be frequently drained and an occasional "U" in the main, with a drip and cock at the bottom, will keep the pipes free of moisture. More than one receiver may often be advantageously used in a plant of large dimensions with intermittent work, one at the compressor, and others near the point of direct service. Reheaters on motors yield undoubted economy when used on a machine operating continuously for several hours. On cranes used infrequently, or on other intermittent work, it is doubtful if they would show much gain unless used in connection with an automatic attachment which partially turned off the heater while the motor was not operating. On cranes used almost continually, as in pipe foundries, a reheater at each engine would bring the air geared hoist very near, if not above the electric hoist in mechanical efficiency. Direct acting cylinder hoists should be kept well oiled. A good quality of "neatsfoot"

oil has been thus far found most suitable for preserving and softening the packing used in the pistons. Oil should not be allowed to get onto the rubber hose, unless a specially prepared hose is used; it causes it to decay. The pipe line, when first installed, should have all dirt or dust blown out before attaching it to the machines. An air hoist should be loaded and copiously oiled, and raised and lowered several times when first put into service to get it into good working order. A pressure of 60 to 100 pounds has been found most convenient for general use.

Briefly summarizing, air is undoubtedly a most convenient power to subdivide into many small hoisting units, and when so used shows high mechanical efficiency, and a large saving in handling products. It is more easily applied to geared traveling or jib cranes than either electricity, steam or belt power, and compares favorably in mechanical efficiency with either, and is in many cases actually more economical than either when so used. It is easily installed, of comparative low first cost, and can be taken care of by an ordinary machinist. It is handled without danger, and therefore is an ideal portable power. It is worthy of serious consideration not only as a hoisting power, but as the exclusive transmission power of the modern foundry.

Latest Foundry Practice in Casting Aluminum.

The use of aluminum castings in the arts and manufactures has become such a common occurrence that one does not have to look very far at the present time to find a brass founder who is familiar with making good aluminum castings. Nevertheless, as questions are always arising as to the best methods of procedure, a few remarks on the present foundry practice may not be out of place.

The character of work for which aluminum is being used in castings to-day is of too varied a character to go very much into detail as to specific uses, but generally speaking, they are extensively used in the moving parts of weaving and printing machinery, and also in centrifugal machines. In this latter place aluminum castings probably show to better advantage than in any other specified use to which the casting can be put, for the reason that the force tending to break a casting is directly in proportion to its momentum, and the momentum is equal to the square of the velocity of the moving part multiplied by its mass, and in replacing brass castings with aluminum castings, we have only one-third the weight; consequently as this is a direct function of the mass, we have the force required to start the piece in motion, or to disrupt it after it is in motion, only about one-third that which is required or produced when a similar brass casting is used.

Aluminum castings in machinery are also used in a great number of machines which come in contact with various acids and organic substances, as generally speaking, aluminum is not as readily attacked as a brass or bronze casting would be by these solutions.

There is still another class of machinery and machine work where aluminum castings can be used to advantage, and that is in parts of portable machinery, where the weight in moving plays an important part, as you only have about one-third as much weight of material to handle, which, if handled by physical force, makes the work very much easier, and if by mechanical force, such as by express or freight shipments, the express or freight would only be one-third, which in many instances is quite an item.

In confining ourselves, however, more particularly to the manufacture of aluminum castings, these castings can be made in any ordinary foundry fitted for making brass castings. The crucible that should be used is a plumbago or black-lead crucible, and the metal is melted preferably over a coke fire. If this is not convenient, however, a fire of charcoal, oil or gas can be used, and are desirable about in the order named. The great object is to use a fuel which is free from nitrogen, phosphorous and silicious gases. It is not advisable to use a fuel of either hard or soft coal, because of the fact that these fuels contain more or less of these gases, which, to a certain extent, will be absorbed by the metal and will cause blowholes. If the fuels are used which are here recommended, it will not be found necessary to cover the metal with any substance to prevent it oxidizing.

After the metal is melted it should be removed from the fire and cooled down to the proper temperature for pouring; it, generally speaking, should be very little above the

melting point, or when the metal is about a dark cherry red, although the exact temperature at which the best results can be obtained is a matter which can only be determined accurately by experience, for the reason that castings with parts of different thicknesses require the metal to be poured at different temperatures; a thin casting, for instance, should have the metal poured at a little higher temperature in order to get additional fluidity, than would be necessary in pouring a casting composed of thicker parts.

In cooling the metal down to the proper temperature, this should be done by the addition of new metal, after the crucible of molten metal has been removed from the fire, but the metal should not be allowed to grow cold by standing, nor should it be allowed to stand any longer than is absolutely necessary. This cooling is done by stirring with a bar of new metal, or an old gate, or something of that sort, and it will be easy to see by the rapidity with which the metal that is added melts, just how much it is desirable to add. After the metal is once started to pour a casting, it should be poured from the crucible rapidly, but at a uniform rate.

There is apt to be a certain amount of oxide of aluminum in the metal, and if a very fine class of work or a particularly good casting is desired, this oxide to a certain extent can be removed by the addition of nitrate of potash to the molten metal, which is added in quantities of about one tablespoonful to one hundred pounds of aluminum, and in the following manner: After the pot of metal is removed from the fire, place in a sheet of writing paper which has been dipped in water, the nitrate of potash, and place this on top of the metal. Be prepared instantly with an iron ladle, or something which will answer the same purpose, to push this paper to the bottom of the pot. By the time it has reached the bottom, the paper will have become dried out and burnt, and the nitrate of potash will come up to the surface through the body of the metal, combining with the oxide on its way to the surface. The metal should be continually stirred so as to bring as much of it as possible in contact with the potash. It is best not to use too hot a fire for melting aluminum, for the reason that you are not so apt to oxidize the metal if it is melted gradually and slowly.

Turning our attention to the molds and to the proper molding of patterns for aluminum castings, the best castings are made in iron molds. These molds, however, have to be heated up to the temperature at which aluminum melts. The molten metal is then poured in the molds, and very often they are then returned to the furnace, in order to be sure that none of the aluminum has become chilled when coming in contact with the iron mold. After the mold is removed from the furnace with the metal in it, it is cooled from the bottom upwards by means of slowly immersing it in some cooling bath, or by directing on the mold a blast of air from the nozzle of a hose. In this manner the metal in the mold at any given cross section, cools uniformly and at the same time as the mold, and the metal at the top of the mold supplies the shrinkage, until it in turn has cooled down, thus preventing a shrinkage crack, which often occurs by the metal in the surface of the casting cooling before the metal in the center, due to the fact that the metal next to the surface of the mold is chilled by coming in contact with the cold mold. As this method of casting, however, is not always convenient, if, for instance, it is only desired to make a few castings, it would not be advisable to go to the expense of having an iron mold made for doing the work.

Castings can be satisfactorily made by the use of an ordinary sand mold, such as would be used for a brass casting, the only additional precaution which it is necessary to take being, that the mold should be thoroughly well ventilated, and also that it should have a large gate and high riser. These points cannot be too strenuously insisted upon. The object, of course, is to allow as much of the gas to escape as possible, and it is more necessary in casting aluminum than any other metal to have a large gate and high riser, for the reason that the object to be gained is to have the metal in the body of the casting cooled before the metal in the riser, thereby allowing the metal in the riser to flow in and supply the shrinkage as the aluminum in the body of the casting shrinks, and it is very much more necessary to have large risers in the use of sand molds than it is in the use of hot iron molds, where only small gates are necessary.

As in other castings, of course, the finer the more perfect the surface of the casting, the sand that is used in making the mold, and if it is desired to get an aluminum casting with a very fine surface, the best results can be obtained by first facing the mold with a fine Connecticut sand, which has first been thoroughly dried, and then, after the mold has been faced with it, it should be baked with the smoke from a gasoline torch. If these precautions are followed, the ordinary brass founder will have no difficulty in making successful aluminum castings with but very little trouble and experimenting.—Aluminum World.

Chimmie Powers in St. Louis.

Say: I never seen de streets of Karo, but I seen better times den dose, said Chimmie, as he looked up out of a schooner of beer at Petker's place. St. Louis ain't de only place dat's dull dow; remember dat, I see "bows" evy day frum all 'round de cuntry, an its de same story over agin. Jack Cunningham's 'bout de only one workin' at de Car Wheel Works, an Skinny Dillon's got Timmermann's all to his self, ole Luke Lamb wus laid off at Allens, so you kin imagin what der doin der but de Steinards got de red flag out.

Todd's over in E. St. Louis is doin more den all de res' put togather, wus over der las' week an "soon" Charlie McKenna seen me, he run frum under his hat, to gimme de glad hand, an ses, where yo' workin' Chimmie; I says no place on erth; den he ses come an start fer me, I don't need any one, but I'll lay a man off to put you on, so of corse I couldn't refuse; dat's how it comes I kin sit here an make Petker carry dem to me, he knows I'm workin' an dat settles it.

Say: I seen big Tom Urgam dis summer, de big "guy" dat use to sit in de saloon an lick em up by his self until six o'clock every evening, den come over an take up de heat, an put de blas' on, when he was tryin' to run Todds, do yo' 'now what dat "mug" is doin' now? he ain't doin' a ting but pedlin' umbrelas, an dats no joke; he ain't got no more job den a rabbit. I seen a nuther smooth one to, dat use to be up in Pullman, Chimmie Land; I worked fur him up dere, an say: he wus lookin' fer bread tickets, since de car shops at Madison shut down, he use to run Todds, but dem people improved on him. I lafed de other day when I met ole Simon Burns, he's got de same color yet an de same ole cough, but de funny ting about it wus, he had on a policeman's coat, buttoned all the way up, an it wus a hot day to; I couldn't see wheather he had on a shirt or not. I see McKillop's is gone into business, and is keeping a drunk factory up on Eleventh street,; "Mac" done well when he married de widow. I see Willie Connors has quit the "shell game," an gone to work at las'. And say: I seen Mike Feeney las' night, he wears good togs, but won't work, not even in buggy harness, an dey say he lives like lightning.

I seen Dick Ogden las' week, hes one of Green's reg'lars, but der dull up der, an now ole skinny is drivin' a linen herse; what's a linen herse? why, dat's a laundry wagon. Billy Kennedy wus in here las' week one night, an sed he wus doin' time out at Dutroes yet, he wus tellin' me 'bout de run-out he had, sed when he started to pour wid a crane ladle de run out started an every one in de shop wus tryin' to stop it, but when dey stopped it in one place, it started in an oder; but Billy was game an sted wid it, untill after de whistel blew, but he laid off nex' day, sayin' dat he'd sooner clean up de gangway den his floor, dey wus so much skrap on it, see.

Charlie Dwyer's a guy dat I ain't seen 'roun' St. Louis lately, but say: did you ever hear 'bout de shop he started out in Denver? Nit; well, he went out dere an rented a place dat wus suitable fer a foundry, got a sign painted on de frunt, an had cards printed, an stuck up 'roun' town, had an office, wid sum nice furniture in it, but he couldn't make it go. Why? cause he didn't have any flasks, pig iron, coke, nor patterns, an only 'bout a wheelbarrow full of san'; times wus good den an he cum back to St. Louis an started in de ole Vulcan, makin' ingot molds fer John Robinson. I see George Wheeler's on de turf agin, he went on de pleece force las' spring, an he made a nobby lookin' one, to, wid a blue suit, an his lovely red hair; George was dead easy dough, never pinched any one while he wus on, an de head fellers trun de harpoon into him, now he's wonderin' how it cum. Ole Pete Cooper makes de roun's of de shops yet every once in a while, he's Dick Powers ole side kick; say, did I

ever tell you 'bout de time Pete looked under a flask fer a molder out at de car shops? No; well, when de feller went to pour it, de gaffer wus goin' to skim, an Pete seys to him, its no use to pour dat; Why? ses de gaffer; 'caus its droped out; an say, his nibs didn't do a thing to Pete.

I hear Jim McGrath's got a job cookin' down at de Marine Hospital; say, he's a helva duck; he couldn't cook a hot Tamalie, but hes a stylish mug, de las' time I seen him he had on a pair of shoes dat looked like dey wus clay-washed; he's a pop'lar feller, dough, an at one time he use to be Buck Cat wid de foreman at de Vulcan; he kin carry more of de Bush brew under his vest den any man I ever seen, an never show it, but Jim went to skule, an kin read, rite, an mak figers, and at one time passed examination to be a letter carrier. Say, Pettker, gimme de largest in de house, I got a sand-bar on my stumack. S. E. ATLE.

Fired at Random.

We are making some match-plates and are having trouble on account of the shrinkage, reads a question in the July FOUNDRY. A few years ago I would, in a sort of sympathetic manner, have put my hand on this man's shoulder and, after asking him how crops were getting along in his part of the country, I would have told him that his iron was bad, that his coke was no good, and probably wound up by advising him to make changes that would make his condition worse.

A few years ago Mr. Thomas D. West made an effort to impress upon foundrymen the necessity for a better definition of the word shrinkage. He contended that shrinkage and contraction were two entirely different things, at least as far as metals are concerned. He defined shrinkage as being the loss of volume which takes place while the metal is in a fluid condition, and contraction the loss of volume appearing after the metal becomes solid. The more one will think about this matter, the more convinced will he become of the correctness of Mr. West's contention.

If the above question relating to match-plates reads right, then I will say that the difficulty may be entirely obviated by placing a sufficient number of feeding heads on the casting to supply the loss of volume while the iron remains in a fluid condition. If contraction, however, is what is meant, as it very likely is, I can only suggest one remedy, the best there is: Control your iron mixture.

This subject has been treated to such an extent in THE FOUNDRY that no better reference can be made for information than to some of its numbers, nearly all of which contain more or less matter pertaining to this part of foundry practice. It is love's labor lost to condemn iron and coke, when one has got no system of controlling his mixture, but instead is letting it have free reins to do as it pleases.

The advantage of knowing just what to expect from a certain mixture ought by this time to be pretty well established, yet there are many foundrymen who think they are doing well when they come within an eighth of an inch of the mark. Only last week I came across a new kind of foundry practice. Noticing a laborer breaking pig iron and piling it up in a huge heap, I inquired why he kept changing from one pile to another. He informed me that there was such a thing as number one, two and three of iron. They mix it, says he, and the way they do it is this: I take one pig from each number in turn and fire them altogether.

Inside the shop the foreman complained of getting his castings too long or too short, and right out of the same heat, too, he added. We thought of the arrangement he had for breaking his iron and mixing it. We wondered if it was not possible to get too many pieces of number one sometimes, and again reversing, not get enough. It seemed like luck and lottery if one could all the way through get the right number of pigs of each grade to a charge, not to speak of the right weight, but such is foundry practice, at least in some places; it is run by guesswork, and its offspring, troubles, are numerous.

Shrinkage and contraction become troubles when not regulated, and it is not good medicine to suggest any changes until they are under control.

Iron may shrink much and contract very little. Take a heavy casting, an anvil block, for instance, and the shrinkage will be heavy, while contraction will be below the mark made by lighter castings. The only relationship existing between shrinkage and

contraction may be found in ordinary castings, where a tendency to unusual shrinkage will generally imply an abnormal contraction and vice versa.

I have never seen a bronze that did not shrink and contract. In fact, one of my pleasant memories reminds me of a rudder post and rudder cast together that would contract so much that it kept me awake nights. The post, or round part of it, was cored out with a loam core, while the rudder or flat portion had an ordinary core made on a cast iron anchor. The first one made pulled itself in two in its efforts to contract, and when this was gotten over by using a smaller core barrel and more hay rope, the flat portion began to crack, convincing me that shrinkage and contraction is a most serious matter to deal with in bronze castings.

I don't believe that bronze would prove a very acceptable metal for match-plates, though it might work very well for patterns. There is a certain rigidity about cast iron not possessed by any other metal. Its universal use in places where this is desired proves how well it fulfills this want, and a match-plate ought to be rigid first of all. There is nothing more useless than a bent or crooked match-plate, and with an ordinary amount of rough handling, such as patterns are usually subjected to, a bronze match-plate, unless made of such large dimensions as to make it unwieldy and a hindrance to rapid work, would soon develop crooked symptoms.

The recent building of the Kansas City, Pittsburg & Gulf Railroad into Polk county, Arkansas, and a consequent examination by prospectors connected with the railroad of the manganese deposits in this county, have revealed the fact that they are very much more valuable and extensive than had heretofore been supposed. A report by the State geologist of Arkansas, made in 1890, on this district, rather discredits the quantity and the quality of these deposits, but a careful and systematic examination of portions of this district does not confirm the State geologist's report. It is learned now on good authority that, in place of the deposits being merely pockets of manganese, beds have been found of the formation, and veins extending over the county for many miles are easily traceable by the ordinary prospector; that they vary in width from four inches to six feet, and that the quantity is practically inexhaustible. The quality of this manganese is, in some cases, very high; the ore was supposed to be associated with iron and phosphorus, two materials which detract very greatly from the value of the ore, if it is to be used in steel or glass making. Deposits have been found of almost pure mineral, suitable not only for steel making, but for fine glass making also.

ECONOMIZE ON LIONS.

Iron Molder Had Carefully Felt the Public Pulse.

"Going to start into business here?" remarked a man of sallow skin and sleepy eyes to a bright-looking young fellow who sat beside him in a Cottage Grove avenue gripcar.

"Yes, I have decided not to go to college," the prospective business man went on to say. "What would you advise me to do?"

"Well, you know I am in the iron-molding business. We do all kinds of iron work—make those jockey hitching posts and iron fencing, cast-iron lions, and so forth. The business is all right, but just now I would advise a young man not to go into it. Strike something staple—something the people have to have, rain or shine, hard times or good times—then work it for all it's worth. Let me give you a tip, my young friend, on my business. I have found that the first thing that the public begins to economize in when hard times come is cast-iron lions."—Chicago Post.

The Mallby & Wallace Company, at Champaign, Ill., has made an assignment.

The James P. Witherow Company, New Castle, Pa., has been reorganized as the New Castle.

The entire plant of the Ballardvale Mfg. Company, at Ballardvale, Mass., was bought at sheriff's sale recently by C. I. Rawson, of Worcester, Mass.

It is the good fortune of but few foundries to be able to claim that they have been engaged continuously in business for 60 years, but that magnificent record has just been made by J. S. Lithgow, of J. S. Lithgow & Company, Louisville, Ky.